INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

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Published by the National Oceanic and Atmospheric Administration,
U.S. Department of Commerce, Rockville, Md. 20852

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IFYGL BULLETIN ARTICLES

It is requested that scientists who are or have been conducting studies using IFYGL data submit summary articles for inclusion in the IFYGL Bulletin. The purpose of the Bulletin is to provide documentation of the IFYGL program in all its aspects and to facilitate distribution of information to all interested parties. Results of analysis of IFYGL data being made available will increase the value of the IFYGL data archives and be of help to scientists undertaking further studies based on these and other Lake Ontario data.

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A joint Canadian-United States list of publications related to IFYGL was included in IFYGL Bulletin No. 13, and will appear, cumulatively, in all subsequent issues. Additions will be identified as such in each Bulletin. Any questions, comments, or additions to the bibliography should be addressed to one of the IFYGL Coordinators as follows:

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Official IFYGL Publications

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Canadian Projects Supplement	No. 1 - July	1972
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CANADA

Editor (pro tem)	T.L. Richards
Typing	(Miss) L.S. Tozer

CANADIAN IFYGL DATA AND INFORMATION CATALOGUE

The final Canadian IFYGL Data and Information Catalogue, 204 pages in length, was published during the spring of 1976 and distributed to the IFYGL scientific community by the respective Canadian and United States IFYGL Centres. Additional copies are available from:

Canadian IFYGL Coordinator - ACHC
Atmospheric Environment Service
Environment Canada
4905 Dufferin Street
Downsview, Ontario M3H 5T4
(416) 667-4955

As outlined in the catalogue, Canadian researchers may address requests for data directly to:

Canadian IFYGL Data Bank
Canada Centre for Inland Waters
P.O. Box 5050
Burlington, Ontario L7R 4A6
(416) 637-4292

United States researchers should direct their requests to:

IFYGL Data Manager, Room 17
National Climatic Center, EDS, NOAA
Federal Building
Asheville, N.C.
U.S.A. 28801
(704) 2850, ext. 754; FTS 672-0754

CANADIAN PROJECT REPORTS

Notes:

1. Projects are numbered consecutively.
2. The letters following the number indicate which panel has prime responsibility for the project.

   BC - Biology-Chemistry
   BL - Boundary Layer
   EB - Energy Budget
   ME - Lake Meteorology and Evaporation
   TW - Terrestrial Water Balance
   WM - Water Movement
   F - Feasibility

PREVIOUSLY COMPLETED PROJECTS

Project

1F: *Remote Sensing*

Principal Investigator: K.P.B. Thompson - CCIW

13TW: *Groundwater Flow into Lake Ontario*

Principal Investigator: D.H. Lennox - IWD

14TW: *Hydrology of Lake Ontario*

Principal Investigator: E.A. MacDonald - IWD

16ME: *Airborne Radiation Thermometer Survey*

Principal Investigator: J.G. Irbe - AES

18ME: *Climatological Network*

Principal Investigator: J.A.W. McCulloch - AES

23ME: *Radar Precipitation*

Principal Investigator: D.M. Pollock - AES

24ME: *Climatological Studies*

Principal Investigator: D.W. Phillips - AES

27ME: *Island Precipitation Network*

Principal Investigator: J.A.W. McCulloch - AES

28BL: *Momentum, Heat, and Moisture Transfer*

Principal Investigators: G.A. McBean, H.C. Martin, R.J. Polavarapu - AES

29BL: *Space and Time Spectra*

Principal Investigators: F.B. Muller and C.D. Holtz - AES

30F: *CCGS Porte Dauphine - IFYGL Operations*

Principal Investigator: G.K. Rodgers - CCIW

36EB: *Electronic Bathythermograph*

Principal Investigator: G.K. Rodgers - CCIW

38TW: *Groundwater*

Principal Investigator: R.C. Ostry - OME

40WM: *Coastal Chain Study*

Principal Investigator: G.T. Csanady - University of Waterloo

44BL: *Analysis of Energy Fluxes*

Principal Investigator: F.C. Elder - CCIW

46TW: *St. Lawrence-Niagara River Measuring Program*

Principal Investigator: M.H. Quast - IWD

49TW: *Snow Stratigraphy and Distribution*

Principal Investigator: W.P. Adams - Trent University

54BC: *Groundwater Supply Near Kingston*

Principal Investigator: W.A. Gorman - Queen's University

63ME: *Airborne Water Balance Study*

Principal Investigator: T.B. Kilpatrick - AES

66ME: *Basin Evapotranspiration*

Principal Investigator: H.L. Ferguson - AES

67ME: *Surface Water Temperature Distribution*

Principal Investigator: M.S. Webb - AES

70WM: *Ground Truth for Remote Sensing*

Principal Investigator: A. Falconer - Univ. of Guelph

71EB: *Canadian Radiation Network*

Principal Investigator: J.A.W. McCulloch - AES

72EB: *Floating Ice Research*

Principal Investigator: R.O. Ramseier - DOE, Ice

73EB: *Terrestrial Heat Flow*

Principal Investigator: A. Judge - EM&R

74TW: *Water Level Network*

Principal Investigator: G.C. Dohler

75BL: *Wind and Temperature Fluctuations*

Principal Investigators: S.D. Smith and E.C. Banke - Bedford Institute

76WM: *Surface Wave Studies*

Principal Investigator: G.L. Holland - MSD

79F: *Bathymetric Surveys of Lake Ontario*

Principal Investigator: T.D.W. McCulloch - CCIW

80EB: *IFYGL Radiation Balance Program*

Principal Investigator: J.A. Davies - McMaster University

81BC: *Materials Balance - Lake Ontario*

Principal Investigator: S. Salbach - OME

82BC: *Lake Ontario Zooplankton Migration*

Principal Investigator: J.C. Roff - University of Guelph

94: *Data Retransmission by Satellite*

Principal Investigator: H. MacPhail - CCIW

95WM: *Hydrodynamic Modelling*

Principal Investigator: T.J. Simons - CCIW

97BL: *Meteorological Buoy Measurements*

Principal Investigator: F.C. Elder - CCIW

98BC: *Lake Ontario Cross Section Study*

Principal Investigator: M. Munawar - CCIW

101BC: *Lake Ontario Primary Production Study*

Principal Investigators: M. Munawar and J.E. Moore

102BC: *Lake Ontario Diel Pigment Variation*

Principal Investigators: W. Glooschenko and M. Munawar - CCIW

103BC: *Pesticide Concentration in Bird's Eggs*

Principal Investigator: M. Gilbertson - CWS

107BL: *Air Pollution Sinks*

Principal Investigator: D.M. Whelpdale - AES

108BL: *Lake Level Transfer*

Principal Investigator: G.C. Dohler - MSD

110WM: *Hydro Intake Study*

Principal Investigator: A. Arajs - OH

111WM: *Lakeview Dispersion Study*

Principal Investigator: M.D. Palmer - OME

115WM: *Wave Climatology*

Principal Investigator: H.K. Cho - CCIW

116TW: *Airborne Gamma Ray Snow Survey*

Principal Investigator: H.S. Loijens - IWD, Glaciology

117ME: *APT Photographs*

Principal Investigator: J.A.W. McCulloch - AES

ACTIVE PROJECTS

5BL: *Direct Measurement of Energy Fluxes*

Principal Investigator: M. Donelan - CCIW

A number of papers have resulted from this project to date, and are listed in the Bibliography under the Principal Investigator. An interim report including all valid profile data from this project is now available from the Canadian IFYGL Data Bank.

8EB: *Shore Gauging Stations of Water Temperature*

Principal Investigator: D.G. Robertson - CCIW

A report on the results of the observations will be incorporated with the final report on Project 42EB by F.M. Boyce.

11TW: *Monthly Water Balance of the Lake Ontario Basin*

Principal Investigator: D.F. Witherspoon - IWD, Cornwall

The calculations for this project are complete. A first draft, to be included in the IFYGL Summary Scientific Report Series under, "The Terrestrial Water Balance of Lake Ontario and its Basin", is scheduled for completion in January, 1977.

12TW: *Monthly Water Balance of Lake Ontario*

Principal Investigator: D.F. Witherspoon, IWD, Cornwall

This project is essentially complete. A first draft, to be included in the IFYGL Summary Scientific Report Series under, "The Terrestrial Water Balance of Lake Ontario and its Basin", is scheduled for completion in January, 1977.

15BL: *Space Spectra in the Free Atmosphere*

Principal Investigators: G.A. McBean and E.G. Morrissey - AES

Work is continuing on this project. A recent scientific paper, "Scaling Turbulences in the Planetary Boundary Layer" by G.A. McBean has been submitted for review and subsequent publication in, "Atmosphere", Canadian Meteorological Society.

20ME: *Bedford Tower Program*

Principal Investigators: J.A.W. McCulloch and D.W. Phillips - AES

The final reduction of data from three deep water lake towers was completed, documented and sent to the Canadian Data Bank in mid-June.

21ME: *Canadian Shoreline Network*

Principal Investigator: J.A.W. McCulloch - AES

Data tapes for six Canadian shoreline stations: Port Weller, Burlington, Toronto Headland, Darlington, Cobourg, and Point Petre were submitted to the Data Bank in November, 1975.

22ME: *Synoptic Studies*

Principal Investigators: R.F. Cake and D.W. Phillips - AES

Problems arose in analyzing the meteorological situations described in Bulletin No. 18 because of the paucity of over-lake data during these events. Other synoptic episodes, with more abundant Field Year data, are now being investigated. One event which shows promise is the passage of a cold front across Lake Ontario on December 6-7, 1972.

25ME: *Lake Ontario Evaporation by Mass Transfer*

Principal Investigators: D.W. Phillips and J.G. Irbe - AES

Monthly and daily evaporation estimates have been prepared by a modified mass transfer method. Regression equations requiring fetch, and surface water temperature over that fetch, as well as the thermal dynamic variables, are used to estimate the latent heat flux at 88 grid points over the lake. Results have been described in the paper, "A Comparison of Mass Transfer Estimates of Evaporation from Lake Ontario During IFYGL", which has been submitted to the Evaporation Synthesis Panel for study and a scientific journal for publication consideration.

This project is now complete.

26ME: *Over-Water Climatological Ratios*

Principal Investigators: D.W. Phillips and J.G. Irbe - AES

To date approximately 8,000 lake observations from buoys and ships have been paired with simultaneous land observations. This archive will be used to derive over-land/over-water climatological ratios for temperature, humidity, wind speed and direction, pressure, and precipitation. Sorting the simultaneous data by stability, fetch and other criteria will be attempted to derive average ratios and measures of their variability.

32EB: *Thermal Bar Study*

Principal Investigator: G.K. Rodgers - CCIW

The results of the study regarding the heat content change of Lake Ontario are available and further work on this project is now planned.

34WM: *Circulation Near Toronto*

Principal Investigator: G.K. Rodgers - CCIW

A final report is in preparation.

42EB: *Heat Storage of Lake Ontario*

Principal Investigator: F.M. Boyce - CCIW

This project is complete. A paper, "Heat Content of Lake Ontario and Estimates of Average Surface Heat Fluxes", by F.M. Boyce, W. Moody and B. Killens has been submitted to the Inland Waters Directorate's Scientific Series for publication.

43EB: *Internal Wave Measurements*

Principal Investigator: F.M. Boyce - CCIW

This project is complete. A paper, "Some Observations of Freely Propogating Internal Waves in Lake Ontario", was published in the Proceedings of the I.J.C. Workshop on Lake Dynamics, Windsor, Ontario, February, 1976. A comprehensive paper, "Temperature Transects of Lake Ontario", by F.M. Boyce and C.H. Mortimer has been submitted to the Inland Waters Directorate's Scientific Series for publication.

45WM: *Lake Current Measurements*

Principal Investigator: E.B. Bennett - CCIW

A first draft, to be included in the IFYGL Summary Scientific Report Series under, "Water Movements", is scheduled for completion in February, 1977.

62ME: *Evaporation Synthesis*

Principal Investigator: H.L. Ferguson - AES

A first draft, to be included in the IFYGL Summary Scientific Report Series under, "Evaporation Synthesis", is scheduled for completion in March, 1977.

64ME: *Atmospheric Water Balance Study*

Principal Investigator: H.L. Ferguson - AES

A first draft, to be included in the IFYGL Summary Scientific Report Series under, "Atmospheric Water Balance", is in preparation and is scheduled to go to the Scientific Editors in December, 1977.

65ME: *Special Shoreline Evaporation and Network*

Principal Investigator: J.A.W. McCulloch - AES

The data collection was completed in 1973. Processing was undertaken by the Office of Hydrology, U.S. National Weather Service, NOAA, and in early 1976 final estimates of pan evaporation were sent to the Data Bank.

This project is complete.

68F: *CCIW Supporting Resources*

Principal Investigator: P.G. Sly - CCIW

Continues.

69TW: *Pleistocene Mapping*

Principal Investigator: M. Lewis - GSC

Manuscript maps have been completed and are being prepared for final printing.

83BC: *Cooperative Studies of Fish Stocks*

Principal Investigator: W.J. Christie - OMNR

A first draft of the IFYGL Summary Scientific Report, "Status of the Biota of Lake Ontario", is tentatively scheduled for completion in January, 1977.

84BC: *Cladophora Growth*

Principal Investigator: G.E. Owen - OME

Last report, Bulletin No. 18.

85BC: *Nutrient Cycles - Lake Ontario*

Principal Investigator: A.S. Fraser - CCIW

Some of the findings of this study were presented at the 19th Conference on Great Lakes Research at Guelph, Ontario, May 4-6, 1976. The final report submission for this project is nearing completion.

89WM: *Turbulent Diffusion Studies*

Principal Investigator: C.R. Murthy - CCIW

Last report, Bulletin No. 18.

104BC: *Rain Quality Monitoring*

Principal Investigator: M. Shiomi - CCIW

No report available. See Bulletin No. 9 for last complete report.

109WM: *Upwelling Study*

Principal Investigator: G.K. Rodgers - CCIW

A final report is in preparation.

112BC: *Threespine Stickleback*

Principal Investigator: E.T. Garside - Dalhousie University

No report available. Last reported in Bulletin No. 9.

PROJECTS WITHDRAWN
(due to lack of sufficient funds or changes in personnel)

3WM: *Statistical Predication of Lake Currents*

Principal Investigator: H.S. Weiler - CCIW

47TW: *Computer Modelling*

Principal Investigator: L.E. Jones - University of Toronto

78TW: *Basin Water Balance*

Principal Investigator: M. Sanderson - University of Windsor

UNITED STATES

Editors	Fred Jenkins and May Laughrun
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ONE- AND TWO-GYRE CIRCULATIONS IN HOMOGENEOUS LAKES

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Abstract. Neither numberical models nor observations clearly indicate whether one-or two-gyre circulation patterns are more common in homogeneous lakes with bowl-shaped bathymetry. The effect of both wind stress curl and bottom slope are examined and compared. Results show that the percentage change in wind speed across the lake from the central to the shore zone determines whether one lake-scale gyre or two counter-rotating gyres occur.

Introduction

There have been numerous studies of steady circulation in homogeneous lakes. Some have been numerical (e.g., Rao and Murty, 1970; Paskausky, 1971); some analytical (e.g., Csanady, 1973); and others a combination of both (e.g., Bennett, 1974). All these studies, except the one by Paskausky, show that steady circulations in homogeneous lakes with bowl-shaped bathymetry have two counter-rotating gyres, with transport in the direction of the wind nearshore and against the wind offshore. Paskausky's results, however, show only a one-cell circulation, rotating in the direction of the applied wind curl.

Recent studies of steady circulations based on large-scale buoy network data (Pickett, 1975, 1976) have provided monthly mean circulation patterns in Lake Ontario. In November 1972, for example, the lake was nearly homogeneous, and the current data indicated a counterclockwise gyre covering most of the lake.

Since the number of gyres is unclear from both models and data, the conditions for one- and two-gyre steady-state patterns are examined in this note, which shows that one gyre should occur when there is a large percentage change in the mean wind speed across the lake.

Method

Consider the horizontal equation for linear, steady flow in a homogeneous lake on a rotating earth. Let the notions be quasi-static so that the pressure gradient is independent of depth:

$$fk \times v = -\frac{\nabla P}{\rho} + \frac{\partial \tau}{\partial z},$$

where

f = Coriolis parameter
k = unit vertical vector
v = horizontal velocity vector
P = pressure
ρ = density
τ = stress vector, and
z = vertical coordinate

Since the steady flow is horizontally nondivergent, a stream function (ψ) can be defined so that

$$-\frac{f\nabla\psi}{h} = -\frac{\nabla P}{\rho} + \frac{1}{\rho}\frac{\partial\tau}{\partial z},$$

where h = water depth.

The solution for steady circulations can now proceed in two ways. One could vertically integrate eq. (1), incorporate the upper and lower boundary conditions, and then form the vorticity equation to eliminate the pressure term. Alternatively, one could first form the vorticity equation, and then integrate vertically.

The former procedure, followed by Rao and Murty, is common in oceanographi studies (e.g., Sverdrup, 1947). Vertical integration of eq. (1) gives

$$-f\nabla\psi = \frac{-h\nabla P}{\rho} + \frac{\tau_s - \tau_b}{\rho},$$

where the subscript s is the surface and b the bottom stress. The vertical vorticity equation is obtained by dividing by h and taking the curl:

$$-\nabla x\left(\frac{f\nabla\psi}{h}\right) = \left(\nabla x\ \frac{\tau_s}{\rho h}\right) - \nabla x\left(\frac{\tau_b}{\rho h}\right). \tag{2}$$

Since the surface stress is known, closure of the above equation is obtained by prescribing the bottom stress as a function of velocity.

In the sceond precedure, followed by Paskausky, the curl operator is first applied to eq. (1):

$$-\nabla x\left(\frac{f\nabla\psi}{h}\right) = \frac{1}{\rho}\ \nabla x\ \frac{\partial\tau}{\partial z}.$$

On integrating this equation through depth, one obtains

$$-\nabla x\left(\frac{f\nabla\psi}{h}\right) = \frac{1}{h\rho}\ \nabla x\ (\tau_s - \tau_b) - \frac{1}{h\rho}\left(\frac{\partial\tau}{\partial z}\right)_{-h} x\nabla h. \tag{3}$$

This second approach produces the term $(\partial\tau/\partial z)_{-h}$, about which nothing is known. One way to relate this term to the surface and bottom stress is to assume that the vertical gradient of internal stress is uniform, and is due to the difference between surface and bottom stresses, i.e.,

$$\left(\frac{\partial\tau}{\partial z}\right)_{-h} \sim \frac{\tau_s - \tau_b}{h} .$$

Equation (3) then becomes

$$-\nabla x\left(\frac{f\nabla\psi}{h}\right) = \frac{1}{h\rho} \nabla x (\tau_s - \tau_b) - \frac{1}{h\rho}\left(\frac{\tau_s - \tau_b}{h}\right) x\nabla h , \quad (4)$$

which is the same as eq. (2).

Results

Equations (2) and (4) are familiar from ocean studies. However, in such studies the depth is usually assumed constant, and the important factors are the variation in the Coriolis parameter and the wind curl. With constant depth and no bottom stress, the equations reduce to Sverdrup's solution for interior flow. With constant depth and a linear bottom friction, Stommel's (1948) equation for westward intensification is obtained. For lakes, on the other hand, the Coriolis parameter is usually assumed constant, and the important factors are the wind curl and the depth variations.

Paskausky followed the second derivation procedure, but omitted the second term in eq. (4) and thereby ignored the depth variation factor. Consequently his results only show a one-gyre, wind-curl driven circulation.

To assess the relative importance of the two factors, they can be isolated by breaking the first term on the right of eq. (2) into two parts:

$$\nabla x\left(\frac{\tau_s}{\rho h}\right) = \frac{1}{\rho h}\left\{\nabla x\tau_s - \frac{1}{h}\tau_s x\nabla h\right\} ,$$

where the first part is the wind curl effect, and the second part is the bottom slope effect. To compare their relative magnitudes, the ratio of the two parts is formed:

$$\frac{\text{wind curl effect}}{\text{bottom slope effect}} = \frac{\nabla x\tau_s}{\frac{1}{h}\tau_s x\nabla h} .$$

Simplifying to a one-dimensional, incremental form, e.g., by considering a west wind, we obtain

$$\frac{\text{wind curl effect}}{\text{bottom slope effect}} = \frac{\frac{\Delta\tau}{\Delta y}}{\frac{\tau\Delta h}{h\Delta y}} .$$

Assuming the wind stress if proportional to the wind speed squared (W^2),

$$\frac{\text{wind curl effect}}{\text{bottom slope effect}} = \frac{2\,W\,\frac{\Delta W}{\Delta y}}{\frac{1}{h}\,W^2\,\frac{h}{\Delta y}} = \frac{2\,\frac{\Delta W}{\Delta y}}{\frac{1}{h}\,W\,\frac{\Delta h}{\Delta y}} .$$

If one evaluates the changes in the above terms by comparing values in the central portion of the lake ($h \sim h_{max}$) to those across the lake at the north shore ($h_{min} = 0$), then Δy's are equal, $\Delta h = h_{max} - h_{min}$, and $h \sim (h_{max} + h_{min})/2$, so that

$$\frac{\text{wind curl effect}}{\text{bottom slope effect}} \sim \frac{\Delta W}{W} \sim$$ percentage wind speed change from central basin to shore.

In general, whenever the lateral shear of a wind from any direction is sufficient to make this ratio approach one, the wind curl effect will tend to dominate and the lake will have a one-gyre pattern. Otherwise, the lake will have a two-gyre pattern.

The above ratio was tested in the Rao and Murty model. A 100-percent wind speed change from the center of the lake to the shore (wind decreasing to calm at one shore) overpowers the two-gyre pattern and produces a one-gyre pattern. This overpowering occurs for all wind directions. For a 50-percent change in wind speed, currents in the gyre rotating against the wind curl are reduced, while currents in the gyre rotating with the wind curl are increased. The result is a lopsided pattern, with the strong gyre eroding the region of the weak gyre.

Discussion

The bottom slope effect induces a two-cell steady circulation in a lake with bowl-shaped bathymetry; the wind stress curl induces a one-cell circulation. The final pattern depends on the relative strength of the two effects, which can be expressed as the percentage change in the mean wind speed from the center of the lake to the shore.

The relative strength of the two effects on a lake is probably determined by the paths of storms. Paskausky's model shows that a storm passing directly over a lake will impose wind speed changes in the wind components across the lake both from shear and streamline curvature.

In addition to the storm track effect, an air-lake temperature difference might also help produce one gyre. Since the wind speed appears in the denominator of the ratio, small wind changes across a lake in months with light winds will result in large percentage changes. These small mean wind

changes might arise because in winter the lake is warmer than the air. This temperature difference could produce a local low-pressure system, which could in turn provide a mean wind vorticity and hence a wind speed difference.

Under either of the above conditions, the mean wind could have sufficient shear to produce a one-gyre circulation pattern such as the one Pickett observed in Lake Ontario in November 1972.

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AN OBJECTIVE ANALYSIS SCHEME FOR LAKE CURRENTS

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Lake Ontario monthly mean current data taken during IFYGL have been presented in IFYGL Bulletin Nos. 15 and 17, and by Pickett (1975, 1976). Circulation patterns inferred from these monthly means are sometimes simple and sometimes complex, but always dependent on the interpreter. One way to avoid this ambiguity is to use an objective analysis scheme, such as the following.

Long-time averages of flow in lakes are nearly nondivergent. As a result, horizontal transport, $\underline{M}$, can be represented by a stream function, ψ, so that

$$\underline{M} = \underline{k} \times \nabla\psi \, , \tag{1}$$

where $\underline{k}$ is the unit vertical vector and ∇ the horizontal gradient operator. The vertical component of the curl of eq. (1) is the vertical vorticity equation,

$$\nabla^2\psi = \underline{k} \cdot \nabla \times \underline{M} \, . \tag{2}$$

If the transport is known, eq. (2) represents a Poisson equation for the stream function.

Equation (2) was used for stream function analysis of tropical winds by Hawkins and Rosenthal (1965). In the atmosphere the boundary condition was given in terms of the wind at the edges of a computational grid. From these winds the normal derivative of the stream function was estimated. For lake currents, the objective analysis scheme follows the Hawkins and Rosenthal procedure, except the boundary condition is that there is no normal transport ($\psi = 0$) along the border of an irregularly shaped grid representing the lake. Another more elaborate approach is to expand ψ in terms of an orthogonal set of functions that satisfy the boundary condition $\psi = 0$. The coefficients are determined by using eq. (1) to fit ψ to the data in a least squares sense. In a future report this method will be compared with the present scheme.

The objective analysis consists of three major steps. First, transports are calculated at each current meter location, and from these locations a rectangular grid is filled with interpolated transports. The interpolation scheme weights the three transports nearest each grid point by the inverse of their distances squared, sums them, and divides by the sum of the weights to obtain the interpolated transport. Several interpolation schemes were tested, but they had little effect on the final results. Next, eq. (2) is solved by using an iterative relaxation scheme on the finite difference form

of the equation. Convergence is assumed complete when the maximum change in ψ divided by the difference between the maximum and minimum ψ at any iteration is less than 10^{-5}. For an over-relaxation factor of 1.72 generally no more than 50 iterations are required for convergence. Finally, the objectively analyzed transport field is obtained by differentiating ψ as indicated in (1).

This method was tested on Lake Ontario current data presented by Pickett (1976) for the month of November 1972. Transport at current meter locations was calculated by vertical integration of the given current components. The analysis was carried out on a grid of 5-km squares. The objectively analyzed streamlines are superposed on the data in figure 1. Vertically averaged current components obtained at the data points by differentiating the stream function and dividing by depth had an rms difference of 2.84 cm s^{-1} from the input data.

The streamlines show several features an analyst might miss. The gradient of the stream function is steeper along the south shore, indicating higher transport; there is a southward deviation of the streamlines over the topographic ridge in the north central part of the lake; and a region of cloclwise circulation is present at the eastern end. The resulting circulation pattern is dynamically reasonable and unbiased by the hand of the analyst.

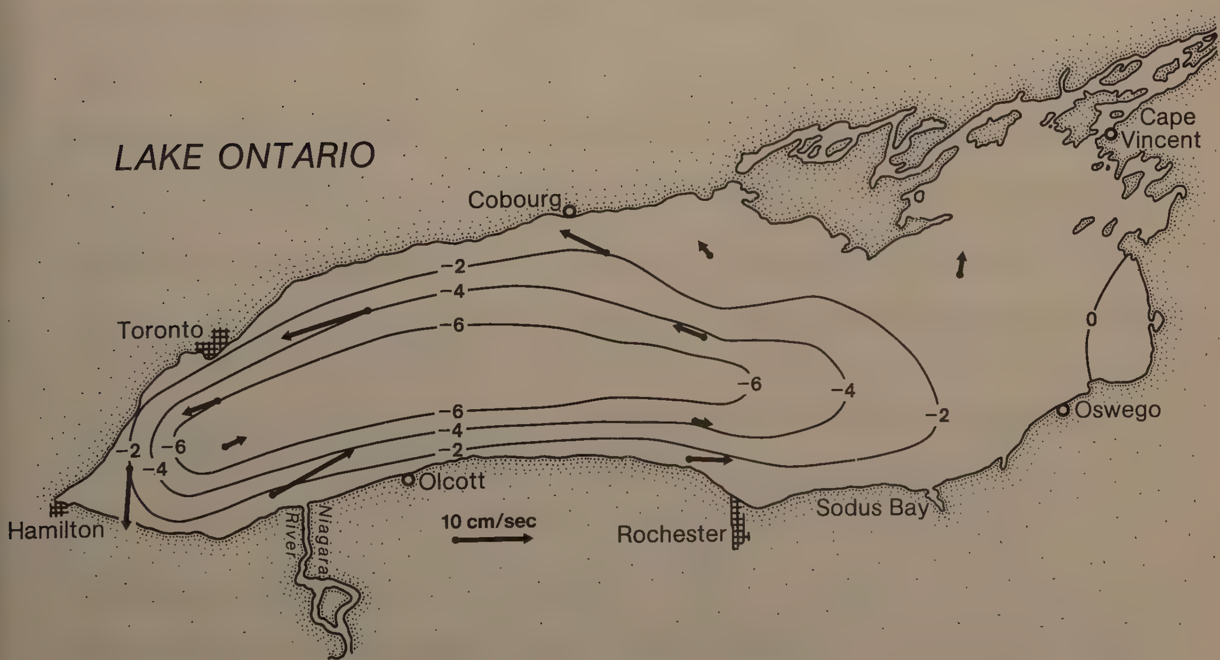

Figure 1.--November mean currents (Pickett, 1976) and objectively analyzed streamlines (10^{10} cm^3 s^{-1}) for Lake Ontario.

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Hawkins, H. F., and S. L. Rosenthal, "On the Computation of Stream Functions from the Wind Field," Monthly Weather Review, Vol.93, 1965, pp.245-252.

Pickett, R. L., "Lake Ontario Mean Temperatures and Currents in July 1972," Journal of Physical Oceanography, Vol. 5, 1975, pp. 775-781.

Pickett, R. L., "Lake Ontario Circulation in November," Limnology and Oceanography, Vol.21, 1976, pp.608-611.

U.S. SCIENTIFIC PORGRAM

The reports below cover the period from January 1 through September 30, 976. Completed tasks are listed first, followed by progress reports on tasks till active. References to task reports are contained in the bibliography n the first section of this issue. IFYGL Archive contents are listed in the inal section.

reviously Completed Tasks

1. *Phosphorus Release and Uptake by Lake Ontario Sediments*

   Principal Investigators: D. E. Armstrong and R. F. Harris - University of Wisconsin

2. *Net Radiation*

   Principal Investigator: M. A. Atwater - CEM

3. *RFF/DC-6 Boundary Layer Fluxes*

   Principal Investigator: B. R. Bean - ERL/NOAA

4. *Nitrogen Fixation*

   Principal Investigator: R. Burris - University of Wisconsin

8. *Runoff*

   Principal Investigator: L. T. Schutze - U.S. Army Corps of Engineers

2. *Transport Processes Within the Rochester Embayment of Lake Ontario*

   Principal Investigator: J. H. Thomas - University of Rochester

9. *Occurrence and Transport of Nutrients and Hazardous Polluting Substances in the Genesee River Basin*

   Principal Investigator: L. J. Hetling - New York State Department of Environmental Conservation

2. *Remote Measurement of Chlorophyll With Lidar Fluorescent System*

   Principal Investigator: H. H. Kim - NASA

3. *Inflow/Outflow Term - Terrestrial Water Budget*

   Principal Investigator: P. L. Cox - U.S. Army Corps of Engineers

25. *Radiant Power, Temperature, and Water Vapor Profiles Over Lake Ontario*

<u>Principal Investigator</u>: P. M. Kuhn - ERL/NOAA

26. *Algal Nutrient Availability and Limitation in Lake Ontario*

<u>Principal Investigator:</u> G. F. Lee - University of Texas at Dallas

29. *Zooplankton Production in Lake Ontario as Influenced by Environmental Perturbations*

<u>Principal Investigator</u>: D. C. McNaught - State University of New York at Albany

32. *Testing of COE (Corps of Engineers) Lake Levels Model*

<u>Principal Investigator:</u> E. Megerian - U.S. Army Corps of Engineers

33. *Nearshore Study of Eastern Lake Ontario*

<u>Principal Investigator</u>: R. B. Moore - State University of New York at Oswego

37. *Simulation Studies and Other Analyses Associated With U.S. Water Movements Projects*

<u>Principal Investigators</u>: J. P. Pandolfo and C. A. Jacobs - CEM

38. *Structure of Turbulence*

<u>Principal Investigator</u>: H. A. Panofsky - Pennsylvania State University

39. *Airborne Snow Reconnaissance*

<u>Principal Investigator</u>: E. L. Peck - NWS/NOAA

45. *Mapping of Standing Water and Terrain Conditions With Remote Sensor Data*

<u>Principal Investigator</u>: F. C. Polcyn - ERIM

46. *Remote Sensing Program for the Determination of* Cladophora *Distribution*

<u>Principal Investigators</u>: F. C. Polcyn and C. T. Wezernak - ERIM

47. *Remote Sensing Study of Suspended Inputs Into Lake Ontario*

<u>Principal Investigators</u>: F. C. Polcyn and C. T. Wezernak - ERIM

9. *Lake Circulation, Including Internal Waves and Storm Surges*

Principal Investigator: D. B. Rao - GLERL/NOAA

2. *Groundwater Flux and Storage*

Principal Investigator: E. C. Rhodehamel - U.S. Geological Survey

3. *Spring Algal Bloom*

Principal Investigator: A. Robertson - GLERL/NOAA

4. *Ice Studies for Storage Term - Energy Balance*

Principal Investigator: F. H. Quinn - GLERL/NOAA

7. *Phytoplankton Nutrient Bioassays in the Great Lakes*

Principal Investigator: C. Schelske - University of Michigan

8. *Runoff Term of Terrestrial Water Budget*

Principal Investigator: G. K. Schultz - U.S. Geological Survey

0. *Analysis of Phytoplankton Composition and Abundance*

Principal Investigator: E. F. Stoermer - University of Michigan

1. *Clouds, Ice, and Surface Temperature*

Principal Investigator: A. E. Strong - NESS/NOAA

2. *Analysis and Model of the Impact of Discharges From the Niagara and Genesee Rivers on Nearshore Biology and Chemistry*

Principal Investigator: R. A. Sweeney - State University of New York at Buffalo

8. *Exploration of Halogenated Hazardous Chemicals in Lake Ontario*

Principal Investigators: G. F. Lee - University of Texas at Dallas
C. L. Haile - University of Wisconsin

0. *Evaluation of ERTS Data for Certain Hydrological Uses*

Principal Investigators: D. R. Wiesnet and D. F. McGinnis - NESS/NOAA

1. *Distribution, Abundance, and Composition of Invertebrate Fish Forage Organisms in Lake Ontario*

Principal Investigator: R. F. Heberger, Jr. - Great Lakes Fisheries Laboratory

73. *Lake Water Characteristics*

Principal Investigator: A. P. Pinsak - GLERL/NOAA

74. *Snow Observation Network*

Principal Investigator: R. B. Sykes, Jr. - State University of New York at Oswego

Tasks Active in 1976

5. *Profile Mast and Tower Program*

Principal Investigator: J. A. Businger - University of Washington

No report.

6. *Status of Lake Ontario Fish populations*

Principal Investigator: J. H. Kutkuhn - Great Lakes Fisheries Laboratory

The final report is in preparation.

7. *Material Balance of Lake Ontario*

Principal Investigator: D. J. Casey - EPA

In May we completed the "IFYGL Comprehensive Materials Balance Report," which consists of five chapters, two of which are introductory. Chapter 3 deals with Lake Ontario materials input, and Chapter 4 with materials in the lake. Chapter 5 describes a model for nutrient accumulation rates in the lake.

Dr. Patricia Clark presented a paper entitled "An Empirical Nutrient Model for Nutrient Accumulation Rates in Lake Ontario" at the EPA Conference on Environmental Modeling and Simulation held in April in Cincinnati, Ohio.

9. *Evaporation (Lake-Land)*

Principal Investigator: L. T. Schutze - U.S. Army Corps of Engineers

Computation tables for monthly and weekly evaporation from Lake Ontario during IFYGL were presented at the meeting of the Evaporation Synthesis Panel on April 12, 1976. Work has started on a draft of the project report.

10. *Simulation Studies and Analyses Associated With the Terrestrial Water Balance*

Principal Investigator: B. G. DeCooke - U.S. Army Corps of Engineers

Work has started and results will be incorporated into the final report.

11. *Land Precipitation Data Analysis*

Principal Investigator: J. R. Weiser - U.S. Army Corps of Engineers

Analysis of the land precipitation data has been completed, and the first draft of the project report is in review.

13. *Soil Moisture and Snow Hydrology*

Principal Investigator: W. N. Embree - U.S. Geological Survey

The final report has been delivered to the U.S. IFYGL Project Office and to the IFYGL Archive at the National Climatic Center in Asheville, N.C.

14. *Boundary Layer Structure and Mesoscale Circulation*

Principal Investigator: M. A. Estoque - University of Miami

See Task 15 below.

15. *Mesoscale Simulation Studies*

Principal Investigator: M. A. Estoque - University of Miami

Our article entitled "A Lake Breeze Over Southern Lake Ontario" was published in the April 1976 issue of the Monthly Weather Review. This work, which covers the two-dimensional aspects of the lake breeze, has been extended to include an observational lakewide study in three dimensions, and has been used in preparing a proposal to the National Science Foundation for studying the theoretical aspects of three-dimensional lake breeze structures.

The observational study of two lake-effect storms, on October 9 and December 7, 1972, has been completed and these two test cases have been simulated with a numerical model. Comparisons between the observations and the simulations are being made.

16. *Water Transfer Across Large Lake*

Principal Investigator: H. W. Stoughton - State University of New York at Alfred

The final report is in preparation. The literature search on the subject of water-level transfers is virtually complete.

17. *Nearshore Ice Formation, Growth, and Decay*

Principal Investigator: J. Dilley - General Electric Company

Simulations were run for three ice periods observed at the Nine Mile Point field site during IFYGL, and were compared with field observations to evaluate the accuracy of the simulations. The PDCS tapes used to compute the surface heat transfer for the two stations, Olcott and Oswego, N.Y., on the U.S. side of the lake had to be edited to eliminate gaps. Simulations were then run of the three ice periods at Nine Mile Point (10 km northeast of Oswego), which were expanded beyond the periods actually observed because the local ice formation was often affected by a thermal plume from a power plant 1 km away. The periods covered were December 14, 1972, through January 3, 1973; January 4 through January 31, 1973; and Febrary 8 through March 7, 1973.

The model performance seems to be very good within its limitations. The computer model simulates an ice sheet forming in response to a heat balance at the water's surface. It does not attempt to simulate ice movement by waves or currents although the eddy diffusivity of the water is a function of both. Neither does it simulate advection of warmer water into the plane of the model. The date of freezing initiation was predicted 2 days early for the December and February periods. These differences can be attributed to thermal plume impingement, which shows up dramatically in the temperature data. The January freeze-up was computed to the day by the model. The melting performance is difficult to evaluate from the field data as the thermal plumes precipitated early break-up of all these ice periods.

The real test of an ice model is comparison of the computed thicknesses with field data, of which few are available. However, the Lake Survey Center (LSC) did collect ice thickness data at five sites on the eastern end of Lake Ontario during IFYGL. Two of the sites closest to our site, Irondequoit Bay, Rochester, N.Y. (100 km west) and North Pond (30 km northeast), are protected bodies of water. Although they are not representative of the open lake, the ice formation processes are very similar in shallow water in the absence of waves and upwelling. The comparison between the computed ice thicknesses at Nine Mile Point for shallow water (0.3 m) and deeper water (8 m) is shown in table 1. The depths for the LSC data are not known. As seen in the table, the computed thicknesses are always less than those observed at North Pond and usually more closely aligned with the Rochester data. This comparison validates the surface heat transfer expressions as being realistic, since they are the driving force behind the ice formation.

The goal of this task has been to compute the time history of the latent heat of fusion released or absorbed during the IFYGL winter on a weekly frequency. To this end, whole-lake simulations were run for a series of depths at four stations. PDCS data were used for the U.S. stations at Oswego and Olcott on the south shore and Canadian meteorological data for the Cobourg and Kingston stations on the north shore. Radiation data provided by Atwater were used for all four stations. Hourly meteorological and

Table 1.--Comparison between observed and computed ice thicknesses (m)

Date	LSC data		Computed values	
	Rochester	North Pond	Nine Mile Point (at 1200 EST)	
	(depth unknown)		Depth	
			8 m	0.3 m
Dec. 21 '72	0	0.10	0.033	0.052
Dec. 28 '72	0	0.10	0	0
Jan. 4 '73	0	0.10	0	0
Jan. 11 '73		0.23	0.14	0.16
Jan. 12 '73	0.13		0.15	0.17
Jan. 18 '73		0.23	0.081	0.11
Jan. 19 '73	0.076		0.050	0.074
Jan. 25 '73		0.15	0.059	0.077
Jan. 26 '73	0.051		0.046	0.065
Feb. 1 '73		0.20	--	--
Feb. 2 '73	0.051		--	--
Feb. 8 '73		0.20	0	0
Feb. 9 '73	0.051		0	0.033
Feb. 15 '73		0.28	0.12	0.16
Feb. 16 '73	0.20		0.14	0.17
Feb. 22 '73		0.28	0.16	0.19
Feb. 23 '73	0.25		0.16	0.20
Mar. 1 '73		0.28	0.22	0.25
Mar. 2 '73	0.20		0.20	0.23
Mar. 8 '73	0	0.10	0	0
Mar. 14 '73		0	0	0

radiation inputs were averaged to coincide with the 4-hr time step that was used to compute daily and weekly fluxes.

In addition to latent heat, the following surface heat transfers were computed: net solar radiation, net thermal radiation, net radiation, evaporative transfer, convective transfer, and the total net surface heat transfer. The resulting weekly summaries are presented in table 2. These values were obtained by interpolating the fluxes between the four stations along depth contours and then multiplying them by the areas between the contours. The table shows that during the three strongest cooling periods, weeks 1, 4 and 9, the convective transfer dominated with about 50 percent of the net transfer. The evaporative transfer was close behind with roughly 40 percent, while the radiation was small, ~10 percent. During the two melting weeks, the radiation, primarily solar, dominated with ~65 percent. The remaining transfer was convective, with the evaporative transfer being less than 5 percent for these periods. These ratios do not necessarily hold for shorter time periods. The net computed heat loss for weeks 1 to 11 was compared with the loss derived from measured temperature profiles and found to be 35 percent low in magnitude, a discrepancy resulting from the fact that the vertical eddy diffusivity in the model is too low. The daily values have also been plotted and are given in the final report, "Lake Ontario Ice Modeling - IFYGL Phase 3 Final Report", by John F. Dilley, GE-RESD report No. 76SDR2209, dated June 1976, which contains details on the nearshore ice simulation modeling and the whole-lake modeling. This reports completes the work on this project. Copies are available from the U.S. IFYGL Project Office, GLERL, Ann Arbor, Michigan, or from the author.

18. *Advection Term - Energy Balance*

Principal Investigator: J. Grumblatt - LSC/NOAA

Due to a printing error in IFYGL Bulletin No. 18 in the article entitled "IFYGL - An Unusually Cold Year," on pp. 59-62, the figure located above caption 4 should be located above caption 2, and the figures located above captions 2 and 3 should be located above captions 3 and 4 respectively. On page 67, paragraph 18, March 1976 should read March 1977.

The final report is in progress and will be submitted for review in December 1976.

20. *Boundary Layer Flux Synthesis*

Principal Investigator: J. A. Almazan - CEDDA/NOAA

The computations of the lake-wide average flux estimates of moisture, heat, and momentum have been completed. The following papers, based on work on this project, were present at the 19th Conference on Great Lakes research:

Table 2.--Whole lake weekly heat transfer summary (J/wk)

Week No.	Net solar radiation	Net thermal radiation	Net radiation	Evaporative transfer	Convactive transfer	Net total	Latent heat (fusion)
1	1.4435E 17	-3.0829E 17	-1.6394E 17	-1.0360E 18	-1.3607E 18	-2.5606E 18	-2.7130E 16
2	1.0984E 17	2.7983E 16	1.3782E 17	-2.9673E 17	-3.4677E 17	-5.0568E 17	5.0772E 15
3	2.3316E 17	-1.4026E 17	9.2902E 16	-6.3862E 17	-7.0073E 17	-1.2464E 18	-1.8699E 16
4	3.4162E 17	-7.0489E 17	-3.6327E 17	-7.7939E 17	-1.1012E 18	-2.2438E 18	-1.7854E 17
5	3.4461E 17	-3.0223E 17	4.2378E 16	-4.5108E 17	-2.9887E 17	-7.0757E 17	-1.4705E 16
6	2.9197E 17	-2.0999E 17	8.1987E 16	-3.9420E 17	-1.0908E 17	-4.2129E 17	4.9945E 16
7	4.3675E 17	-4.2862E 17	8.1273E 15	-6.7969E 17	-8.8139E 17	-1.5530E 18	-1.0056E 17
8	3.4828E 17	-1.2322E 17	2.2506E 17	-3.7672E 17	-2.7227E 17	-4.2394E 17	1.0018E 16
9	5.7511E 17	-8.1638E 17	-2.4128E 17	-6.0855E 17	-1.0228E 18	-1.9446E 18	-2.8151E 17
10	3.8952E 17	-3.1409E 17	7.5431E 16	-4.8868E 17	-6.4540E 17	-1.0587E 18	-2.0704E 17
11	6.7146E 17	-5.3865E 17	1.3281E 17	-4.5900E 17	-4.9654E 17	-8.2274E 17	-2.0721E 17
12	6.7934E 17	7.4467E 16	7.5381E 17	1.6322E 16	3.2038E 17	1.0905E 18	5.7626E 17
13	6.6615E 17	2.0598E 15	6.6822E 17	3.2507E 16	3.6811E 17	1.0688E 18	2.8379E 17
14	5.9985E 17	-1.9711E 17	4.0274E 17	-4.0013E 17	-1.7549E 17	-1.7288E 17	7.3195E 16

Week No.	Date	Volume of ice ($10^8 m^3$)
1	Dec. 14-Dec. 20, 1972	0.87
2	Dec. 21-Dec. 27 "	0.70
3	Dec. 28-Jan. 3, 1973	1.3
4	Jan. 4-Jan. 10 "	7.0
5	Jan. 11-Jan. 17 "	7.5
6	Jan. 18-Jan. 24 "	5.9
7	Jan. 25-Jan. 31 "	9.1
8	Feb. 1-Feb. 7 "	8.8
9	Feb. 8-Feb. 14 "	18.0
10	Feb. 15-Feb. 21 "	24.0
11	Feb. 22-Feb. 28 "	31.0
12	Mar. 1-Mar. 7 "	13.0
13	Mar. 8-Mar. 14 "	3.6
14	Mar. 15-Mar. 21 "	1.2

"A Description of the Weather During IFYGL and Its Comparison to the Climate of Lake Ontario Based on Data From the Surface Buoy Network", by R. Hovanec and J. Almazan.

"Observations on Vorticity and Divergence Fields Over Lake Ontario During IFYGL," by W. Chen.

"A Study of the Effects of Atmospheric Stability and Over-Water Fetch on Wind Speeds Over Lake Ontario During IFYGL," by J. Almazan and R. Hovanec.

The final report is in preparation.

21. *Hazardous Material Flow*

Principal Investigator: G. G. Lee - University of Texas at Dallas

The final report is still in preparation.

24. *Use of an Unsteady State Flow Model To Compute Continuous Flow*

Principal Investigator: R. Wilshaw - U.S. Army Corps of Engineers

Work is still in progress.

27. *Wave Studies*

Principal Investigator: P. C. Liu - GLERL/NOAA

Detailed analysis of the IFYGL data continued. The results of one interesting episode, September 30, 1972, during which a steep trough in the weather system was passing over Lake Ontario, was presented at the Second Conference on Ocean-Atmosphere Interactions of the American Meteorological Scoiety, March 30 - April 2, 1976. The following abstract of the presentation entitled "On the Temporal Growth of Spectral Components of Wind-Generated Surface Waves," was published in the Bulletin of the American Meteorological Society, Vol. 57, No. 1, 1976:

"The evolution of the energy spectrum has always been of primary interest in the study of wind-generated surface waves. The basic physical processes of the evolution are, however, still far from being understood. This paper presents a detailed empirical examination of the temporal behavior of frequency components of the wave spectrum during episodes of growing waves. The deep-water wave data used in this study were recorded in Lake Ontario during 1972, the International Field Year for the Great Lakes. Consecutive spectra of 10-minute duration are used to facilitate the detailed study. The results show that the temporal development of individual spectral components varies among the frequencies, but they can be grouped generally into three spectral ranges: a low frequency range where the components are most sensitive to wind; a high frequency range where the components are mostly independent of time or wind

stress; and a middle frequency range that possesses both high and low frequency range properties. Furthermore, by fitting a smooth cubic-spline curve through the components with respect to time, the rate of change of energy density for each component at the corresponding time duration can be obtained. The results show that within a given spectra there are several discrete distributions of frequency bands where the rates of corresponding energy density are either increasing or decreasing. Four frequencies, characterizing the four main frequency bands, are found to be approximately satisfying the resonance conditions for the theoretical "wave-wave" interactions. This indicates that the non-linear coupling of surface waves is in fact an important process for the wave growth."

28. *Cloud Climatology*

Principal Investigator: W. A. Lyons - University of Wisconsin, Milwaukee

No report

30. *Change in Lake Storage Term - Terrestrial Water Budget*

Principal Investigator: R. Wilshaw[1] - U.S. Army Corps of Engineers

Changes in storage on the lake during the Field Year have been determined Additional analysis of the water level data collected remains to be accomplished.

31. *Soil Moisture*

Principal Investigator: L. T. Schutze - U.S. Army Corps of Engineers

This task has been discontinued but work will be reported upon in the summary report of the Terrestrial Water Balance Panel.

34. *Internal Waves - Transects Program - Interpretation of Whole-Basin Oscillations*

Principal Investigator: C. H. Mortimer - University of Wisconsin, Milwaukee

Data from the following 127 transect cruises have been sent to the IFYGL Archive and are available on microfilm:

	No. of Cruises		
Transect	July	August	October
Braddock Point to Presqu'ile	24	26	22
Oswego to Prince Edward Island	16	17	22

[1] R. Wilshaw has replaced P. L. Cox as Principal Investigator.

Also included are the following comparisons of isotherm depths in the coastal chain sections and neighboring portions of contemporary transects:

Coastal Chain	No. of Diagrams
Rochester	6
Presqu'ile	15
Oswego	7

A final 362-page working report has been prepared with coauthor Farrell Boyce of the Canada Centre for Inland Waters. It includes the material listed above and the material obtained by Canadian vessels on the Olcott-to-Oshawa transect, and contains all the IFYGL transect data, principally in the form of transect diagrams, with intercomparisons of coastal chain data and temperature information from moored instruments. Copies of the working report are available from the IFYGL Project Office, GLERL, Ann Arbor, Michigan.

The final version of the report is to be published as a binational document by Environment Canada.

Further interpretation of the data, with particular reference to the phase relationships of internal Poincaré waves, is proceeding with the help of spectral analysis.

35. Pontoporeia affinis *and Other Benthos in Lake Ontario*

Principal Investigator: S. C. Mozley - University of Michigan

Work on this task has been completed. A paper on the topic was given at the 19th Conference on Great Lakes Research and a final report has been submitted to the National Science Foundation.

36. *Pan Evaporation Project*

Principal Investigators: C. N. Hoffeditz - NWS/NOAA
J. A. W. McCulloch - AES, Canada

No report.

40. *Optical Properties of Lake Ontario*

Principal Investigator: K. R. Piech - Calspan Corporation

The transmissometer and irradiance meter measurements have been submitted to the IFYGL Archive. The data are being put into microfiche form and will be available after copying is completed. A publication documenting analytical results is in preparation.

41. *Storage Term - Energy Balance Program*

Principal Investigator: A. P. Pinsak - GLERL/NOAA

This task has been inactive due to lack of manpower.

42. *Sensible and Latent Heat Flux*

Principal Investigator: A. P. Pinsak - GLERL/NOAA

Hourly averages of the input variables obtained at the United States and Canadian stations on Lake Ontario were used to compute a daily average Bowen ratio, R. From these averages, a daily average R was calculated for the entire lake for April through November 1972. Test indicated no significant difference between 24-hourly R's averaged to obtain a daily R and R computed from daily average variables. Ratios obtained this way compared favorably with direct measurements of latent and sensible heat measured near the mouth of the Niagara River.

In editing, daily average R's at each station greater than $\pm$ 3.0 were filtered out. The cause of extreme R values is a combination of sensor location, accuracy of measurements, and the sensitivity of the equation used to compute R. When water temperature and dewpoint temperature are close, a large R results; some were as high as 650. Sensor accuracy was $\pm$ 0.5°C, but a water temperature change of 0.1°C produces significant changes in R. This combination of sensitivity and measurement error was the basis for filtering to $\pm$ 3.0.

43. *Thermal Characteristics of Lake Ontario and Advection Within the Lake*

Principal Investigator: A. P. Pinsak - GLERL/NOAA

This task is a follow-up of Task 41 and is inactive pending completion of that task.

44. *Oswego Harbor Studies*

Principal Investigator: G. L. Bell - GLERL/NOAA

This task has been completed and a final report placed in the IFYGL Archive.

48. *Island-Land Precipitation Data Analysis*

Principal Investigator: F. H. Quinn - GLERL/NOAA

A report entitled "Eastern Lake Ontario Precipitation Network" has been distributed to various interested individuals. A report on Lake Ontatio indicator stations has been prepared, but an expansion appears desirable before it is released.

Several computer runs have been made to organize the eastern island and land data, and analysis has begun.

50. *Atmospheric Water Balance*

Principal Investigator: E. M. Rasmusson - CEDDA/NOAA

Further comparison of the evaporation estimates for the three periods (October 3-18, October 31-November 14, November 22-December 5, 1972) with those obtained from mass transfer methods, showed a discrepancy in the second time period. The discrepancy was pinpointed to a single 24-hr period with a large amount of missing data and significant rainfall. The combination of disturbed weather conditions and substantial amounts of interpolated data makes the application of our budget technique questionable during that period, and we dropped that period from our data set. This produced better agreement with the mass transfer methods, although our evaporation estimates are generally higher.

We have concluded that errors in precipitation estimates are probably not the cause of the differences between our values of evaporation and those obtained from the mass transfer methods. For instance, the first period (October 3-18) provides the clearest example. Only 1 day had a precipitation rate greater than 1 mm/day. A more typical value was 0.5 mm/day. Yet, the differences in estimates were 2.2 mm/day, averaged over the whole period. It should be noted that the mass transfer values we are using for comparisons are preliminary values, but are likely to be close to the final values.

The analytical phase of this task has been completed. The final report is in preparation.

51 *Evaporation Synthesis*

Principal Investigator: F. H. Quinn - GLERL/NOAA

An Evaporation Synthesis Panel meeting was held at GLERL on April 12, 1976. Evaporation estimates have been received from the Terrestrial Water Budget, Lake Meteorology, and Atmospheric Boundary Layer Panels. Work has been completed at GLERL on the mass transfer technique using buoy and tower data.

55. *Lagrangian Current Observations*

Principal Investigator: J. H. Saylor - GLERL/NOAA

No activity.

56. *Circulation of Lake Ontario*

Principal Investigator: J. H. Saylor - GLERL/NOAA

No activity.

59. *Coastal Chain Program*

Principal Investigator: J. T. Scott - State University of New York at Albany

This task was completed in June, and a final report entitled "A Climatology of Quasi-Steady Circulation Patterns in Lake Ontario From IFYGL Data" has been submitted to the Great Lakes Environmental Research Laboratory. The abstract of the report is as follows:

"Research under this contract (NOAA 4-35481) provides an analysis of the coastal current data from the U.S. and Canadian IFYGL program. One data report provides transport, cross-sections of alongshore velocity, temperature, baroclinic geostrophic currents and hourly wind data for three "alert" periods during 1972. Three reports interpret the data in relation to physical models of Great Lake circulation. Explanations are offered on the cause of cyclonic resultant circulation, the mechanisms of return flow, upwelling and downwelling and on seasonal variation of circulation in the coastal boundary layer. It is recommended that future effort be applied toward synthesizing the IFYGL data on circulation and transport."

63. *NCAR/DRI — Buffalo Program*

Principal Investigator: J. W. Telford - Desert Research Institute, University of Nevada

No report.

64. *Mathematical Modeling of Eutrophication of Large Lakes*

Principal Investigator: R. V. Thomann - Manhattan College

This task is completed and the final report is available from the EPA Large Lakes Research Station at Grosse Ile, Michigan.

65. Cladophora *Nutrient Bioassay*

Principal Investigator: G. F. Lee - University of Texas at Dallas

The final report is still in press.

66. *Sediment Oxygen Demand*

Principal Investigator: N. A. Thomas - EPA

The draft of the final report has been revised. Prepublication copies are available from the EPA Large Lakes Research Station at Grosse Ile, Michigan.

67. *Main Lake Macrobenthos*

Principal Investigator: N. A. Thomas - EPA

A paper on the November 1972 collections will appear in Vol.1, No.2 of the Journal on Great Lakes Research. The draft covering the entire benthos program is still in internal review.

69. *Basin Precipitation - Land and Lake*

Principal Investigator: J. W. Wilson - CEM

Work on this task has been completed. Accomplishments include the following:

Volume 3 of IFYGL Scientific Report No. 2 has been prepared and reviewed prior to publication.

Hourly precipitation distributions for selected storms have been derived and sent to the IFYGL Project Office, GLERL.

A report on "Radar Observed Land/Lake Precipitation Differences" was presented at the 17th Weather Radar Conference, and has been submitted in modified form to the Monthly Weather Review.

Experiments have been made with a numerical model to simulate "lake effect" snowstorms. The model forecasts compare closely with observed radar snow bands and air modification observed by the IFYGL rawinsonde ntework.

A report has been prepared describing the effects of Lake Ontario on the precipitation along the southern shore of the lake. Another report covering the entire span of the IFYGL precipitation project (1970-1976) is also complete, and consists of a summary of data sets generated, reports prepared, and primary conclusions.

72. *Coastal Circulation in the Great Lakes*

Principal Investigator: G. T. Csanady - Woods Hole Oceanographic Institution

"Full" upwelling episodes (in which the thermocline comes to intersect the free surface) observed during IFYGL and during earlier feasibility studies pertaining to IFYGL have been analyzed and related to a simple geostrophic adjustment theory. A formula was derived giving the strength of wind-impulse necessary to produce full upwelling, and the offshore movement of the upwelled front produced by a still larger impulse. Further work is in progress on the distortion of the thermocline surface by a "second" wind-impulse acting on a previously produced full upwelling. A sufficiently strong second impulse was found to produce a frontal countercurrent.

Work continued on the problem of monthly or longer-term mean circulation in the Great Lakes. A paper entitled Mean Circulation in Shallow Seas," containing some general results of this work is now in press with the Journal of Geophysical Research, Oceans and Atmospheres. One component of the mean circulation, apparently important along the north shore of Lake Ontario in the summer, is a residue of topographic waves passing east to west. A linear theoretical model of the residual flow field of decaying topogtaphic waves has been constructed and related to observation. It does not appear that this flow component is practically very important, but it may be a partial explanation of the observed westward flow. The results of this study are contained in a paper entitled "The Arrested Topographic Wave," submitted to the Journal of Physical Oceanography.

Another study now in progress concerns the manner in which the "domed" thermocline is established in July. A simple theoretical model shows that a combination of surface heating and Ekman drift results in the accumulation of warm water in the coastal zone. The geostrophic flow associated with the domed thermocline contributes to the observed mean cyclonic circulation, the mechanism of which has recently aroused considerable debate.

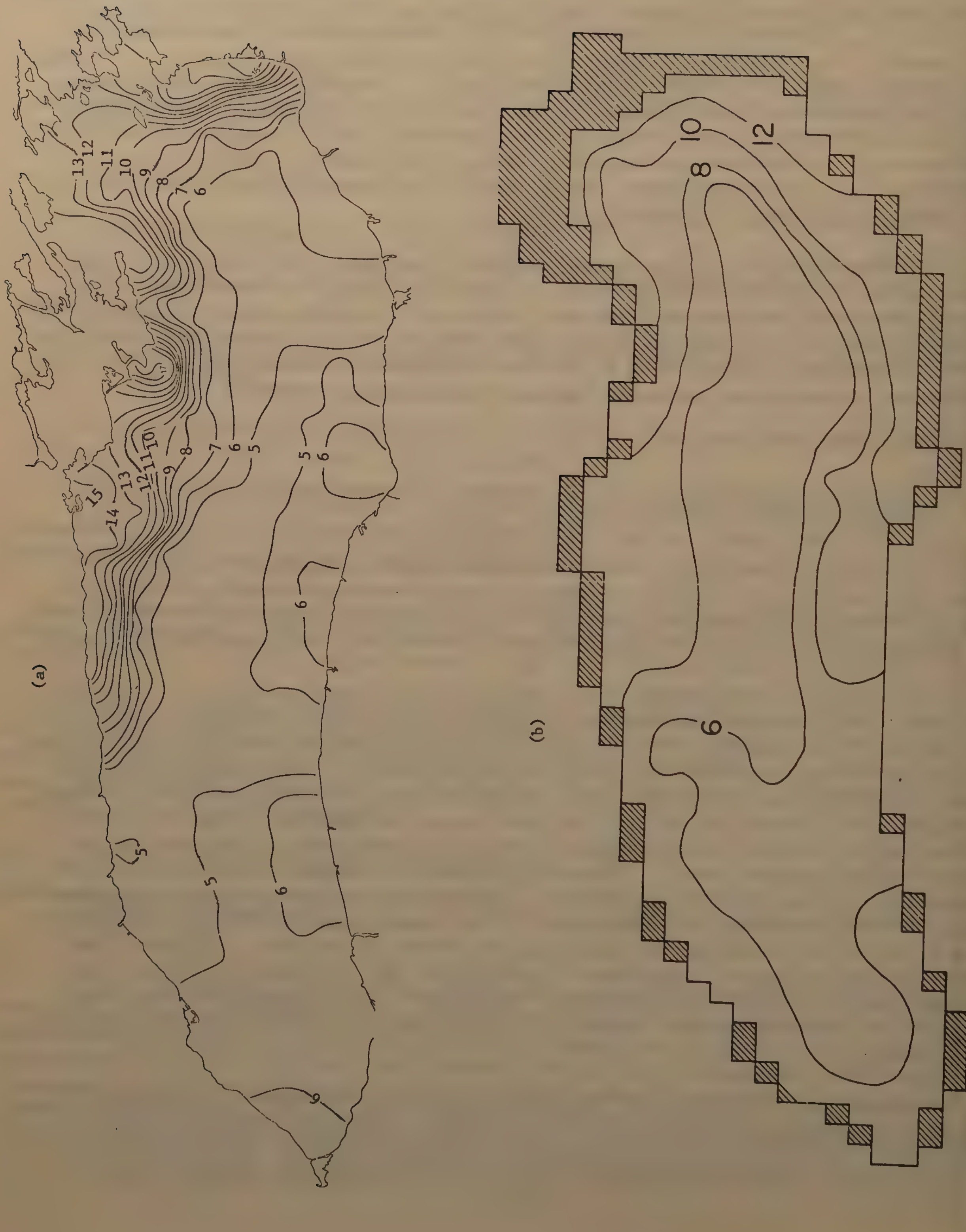
75. *Lake Circulation Model*

Principal Investigator: J. R. Bennett - Massachusetts Institute of Technology

The three-dimensional lake circulation model now simulates well the mean circulation and current reversals due to quasi-geostrophic waves. We are now using it to simulate the dilution of passive dissolved materials and, in collaboration with Carl Chen, to model biological and chemical processes.

The model's improvement over time is illustrated by figure 2. Figure 2a shows the observed average daily temperature of Lake Ontario at depths of 20 to 40 m from August 1 to 3. There is a thin band of warm water along the north shore due to downwelling of the thermocline. The coastal chain data show that this was due to a strong pulse of wind from the west about a week earlier. The direct effect of the wind was a downwelling along the south shore but afterwards it propagated around the east end of the lake as an internal Kelvin wave would. Figure 2b shows the temperature prediction of the earlier 5-km uniform grid model. The model underestimates the propagation speed of the wave and the magnitude of the temperature gradient. Figures 2c and 2d show two cases of the improved stretched grid model. In the first case, 2c, the value of friction is comparable to that used in 2b; in the second, 2d, friction is much lower. With lower friction the thermocline depression travels farther towards the west and the temperature gradient is stronger.

A detailed discussion of this work will be submitted to the Journal of Physical Oceanography soon. A related paper, entitled "A Simple Model of Lake Ontario's Coastal Boundary Layer," has already been submitted; copies are available from John Bennett, 59-1316, MIT, Cambridge, Mass. 02139


(a)
(b)

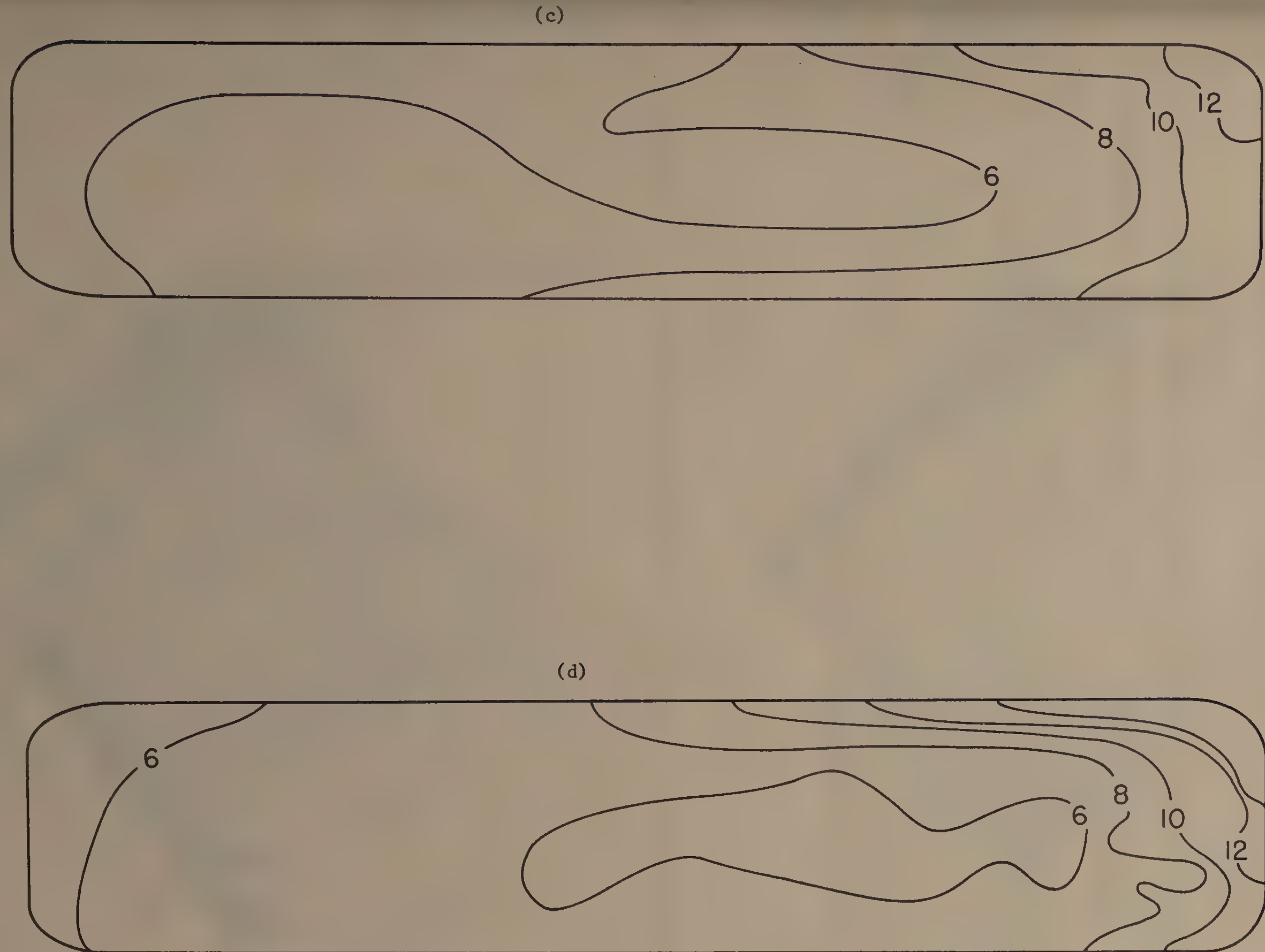


Figure 2.--(a) Observed average daily temperature (°C) of Lake Ontario at depths of 20 to 40 m from August 1 to 3; (b) temperature prediction of the earlier 5-km uniform grid model; (c) and (d) two cases of improved stretched grid model.

76. *Lake Ontario Invertebrate Fauna List*

Principal Investigator: A. Robertson - GLERL/NOAA

The faunal list is complete. General descriptions of the distribution of the benthic organisms have been produced. The same is being done for the zooplanktonic organisms.

77. *Distribution and Variability of Physical Lake Properties*

Principal Investigator: R. L. Pickett and S. Bermick - GLERL/NOAA

In IFYGL Bulletin No. 15 we showed the horizontal distribution of currents in Lake Ontario throughout the summer, and in Bulletin Nos. 17 and 18 the horizontal distribution of temperature from May to November 1972. The temporal distribution of these properties with depth are shown here by means of power spectra in figures 3, 4, and 5. The power spectrum in figure 3 was calculated from all available data at each depth from June through October 1972. Similar spectra for the east-west and north-south current components for the same period are presented in figures 4 and 5.

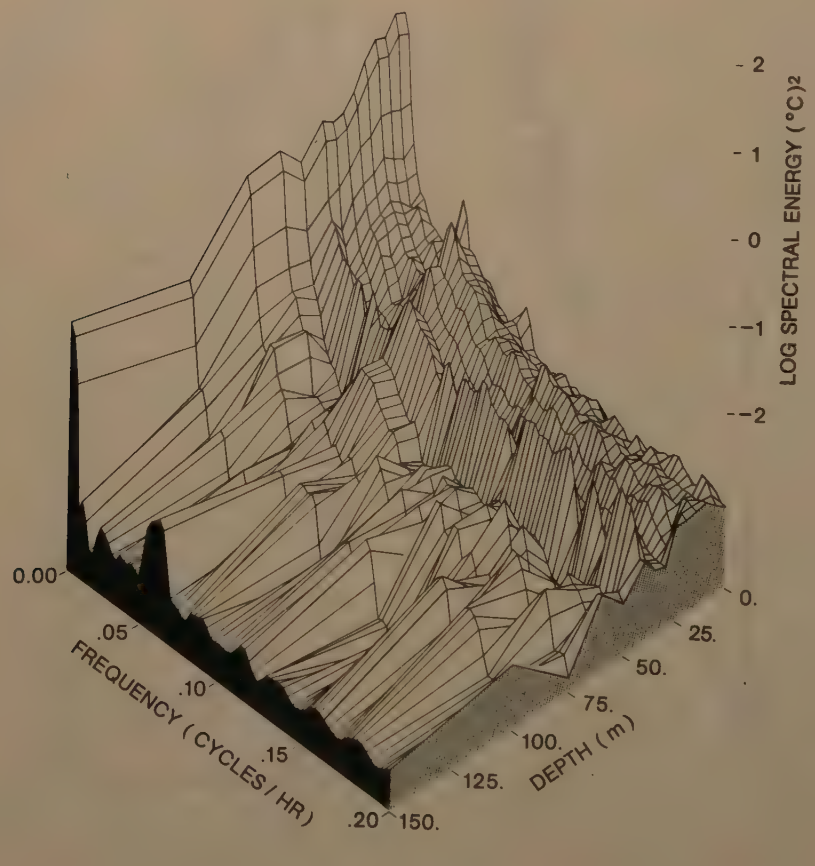


Figure 3.--Lake Ontario summer temperature spectrum.

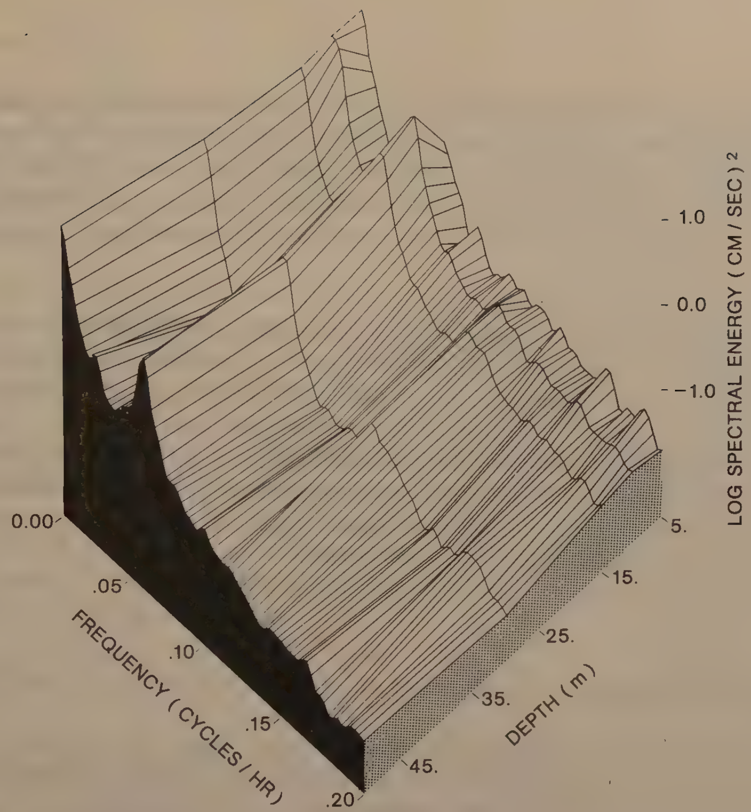


Figure 4.--Lake Ontario summer east-west current spectrum.

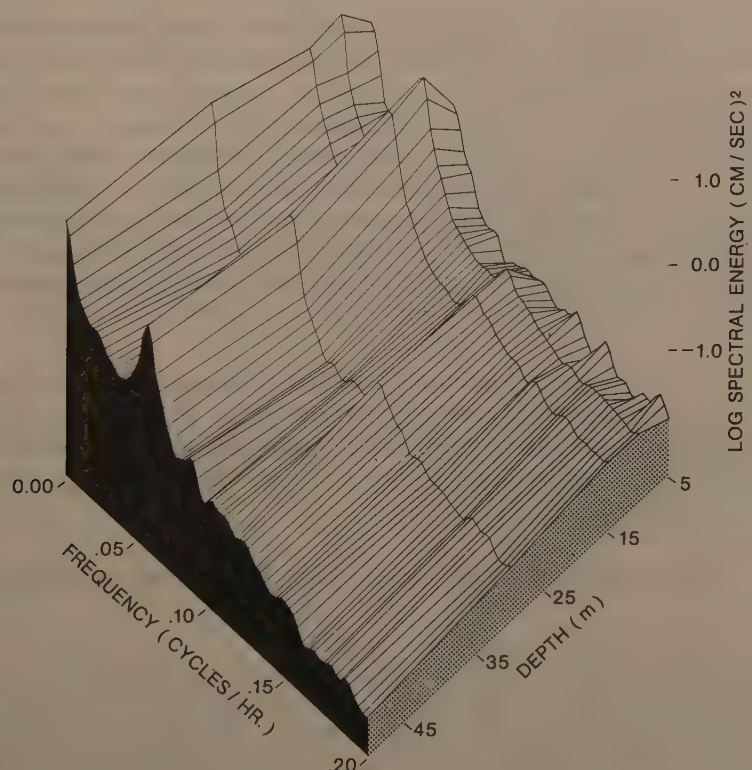


Figure 5.--Lake Ontario summer north-south current spectrum.

The temperature spectrum shows the confused nature of summertime temperature oscillations. In general there is more energy in the lowest frequencies (seasonal changes) and near the surface. At the surface only the seasonal and solar frequencies are significant. Near the thermocline (mean depth, 10 m) near-inertial oscillations are significant and dominate down to the deepest recorded depths.

The two current spectra are nearly identical. There are significant peaks at both the seasonal and inertial frequencies. The inertial oscillations have maximum energy at the thermocline, but are significant on down through the water column. The only difference between the two current spectra is that the east-west spectrum has a significant solar frequency. Although partially hidden in figure 4, this solar frequency extends through the recorded depths. Apparently an offshore-onshore summer breeze influences the currents along the east-west axis of the lake.

78. *Carbon Cycle Model*

Principal Investigators: A. Robertson and B. Eadie - GLERL/NOAA

A paper describing our ecological model for Lake Ontario is in press. An attempt has been made to adapt this model to the other Great Lakes. The results of this work have been published in the Proceedings of the Conference on Environmental Modeling and Simulation (EPA Report EPA 600/9-76-016, 1976, pp. 629-633), and can be summarized as follows:

A one-dimensional ecological model, developed and calibrated for Lake Ontario, has been applied to the other Great Lakes to test its generality. The model, physically segmented into two layers, simulates concentrations of phytoplankton, zooplankton, detritus, phosphorus, nitrogen, and total inorganic carbon. Driving the ecological model with physical data from the other Great Lakes results in accurate simulations for the upper lakes after minor recalibration of the kinetics; however, the western and central basins of Lake Erie could not be simulated due primarily to the effects of physical phenomena that are not considered in the model, e.g., sedimentary regeneration of nutrients, and resuspension.

The kinetic recalibration involved the adjustment of two coefficients, one representing algal phosphorus requirements (the half-saturation constant for growth on phosphorus) and the other determining the regulation by food of zooplankton growth. The adjustment of these coefficients was based on the theory of competitive succession.

As a result of the verification tests the following conclusions were reached:

(1) For an ecological model to be able to predict ecological changes occurring during eutrophication, it must include at least several compartments in each level of the food chain to allow natural selection to be simulated. In this way "recalibration" will take place automatically as succession and adaptation would in nature.

(2) Further investigations are needed to gain insight into the mechanisms that allow phytoplankton and zooplankton to exist in varying environments. The mechanisms governing the succession and adaptation of species will have to be studied in order to develop mathematical relations that describe these mechanisms.

(3) In some lakes, especially shallow ones, the effects of physical and chemical interactions between sediment and the water column can greatly influence the seasonal dynamics of the lake biota. Models should account for these processes when they are important.

(4) The seasonal effects of allochthonous loads should be included in a eutrophication model for lakes with short residence times.

(5) Once the model has been parameterized to include coefficients of the individual phytoplankton and zooplankton groups, it should be broad enough for rather general application.

Panel Report

Boundary Layer - J.Z. Holland, U.S. Panel Cohairman
F.C. Elder, Canadian Panel Cochairman

The panel cochairmen met in Washington, D.C.,on September 30, 1976, to discuss the preparation of the Boundary Layer Scientific Report. Prior to the meeting, reports and copies of published papers submitted by the United States and Canadian panel members to the cochairmen were exchanged for review.

The format of the scientific report will be somewhat different from the one proposed earlier. The report will consist of a review of the results of the flux and profile parameterization work, a summary of the lakewide energy fluxes, and an overall scientific summary of the boundary layer program, including a comprehensive listing of publications. A draft of the report will be sent to the panel members for their comments before the end of the year.

DATA MANAGEMENT - IFYGL ARCHIVE

New Accessions

Catalog Number	Description
USA 3-045-008-001	Analysis of Hydrological Features...using Skylab and Aircraft data
USA 1-044-002-001	SHENEHON 6-Minute Met Data
USA 1-100-015-031	2 Tapes - Oct Cassette and RCC Manual Card Images
USA 1-100-016-055	
CDN 3-005-003-001	Determination of Aerodynamic Drag Coefficient
CDN 3-101-003-001	Phytoplankton Biomass, Species Composition and Primary Production at a Nearshore and Midlake Station of Lake Ontario
CDN 3-066-002-001	A Spectral Investigation of Horizontal Moisture Flux in the Troposphere
CDN 3-066-003-001	The Atmospheric Budgets Program of IFYGL
CDN 3-064-001-001	Monthly Evapotranspiration Estimates for the Canadian Land Portion of the Lake Ontario Basin
CDN 3-049-002-001	Areal Differentiation of Snowcover in East Central Ontario
CDN 3-070-001-001	Studies in the Lake Ontario Basin Using ERTS-1 and High Altitude Data
CDN 3-070-003-001	Photo-optical Contrast Stretching of LANDSAT Data
USA 3-027-007-001	Duration-Limited Wave Spectra in Lake Ontario During the 1972 Hurricane Agnes (IFYGL)
USA 3-034-007-001	The Internal Wave Response of the Lake Ontario Thermocline to the Passage of a Storm, 9-10 August 1972
USA 3-034-008-001	Development of an Automatic Vessel-Operated Temperature Depth Profiling System
USA 3-063-007-001	The Measurement of Wind Structure Near a Lake Surface Part I: Instruments and Accuracy
USA 3-064-002-001	Modeling of Phytoplankton in Lake Ontario
USA 3-067-004-001	Chlorophyll a Profiles of Lake Ontario 1972-1973 (IFYGL)
USA 3-072-002-001	Spring Thermocline Behavior in Lake Ontario During IFYGL
USA 3-077-003-001	Lake Ontario Mean Temperatures and Currents in July 1972
USA 3-078-002-001	A Carbon Budget for Lake Ontario
3-078-002-002	An IFYGL Carbon Budget for Lake Ontario
USA 3-118-008-001	Objective Analysis of IFYGL Surface Meteorological Data (IFYGL)
USA 3-119-003-001	IFYGL Chemical Intercomparisons (IFYGL)
USA 3-048-007-002	Eastern Lake Ontario Precipitation Network
USA 3-007-005-001	An Empirical Model for Nutrient Accumulation Rates in Lake Ontario
CDN 3-005-004-001	Generalized Profiles of Wind Speed, Temperature and Humidity
CDN 3-089-007-001	Helmholtz Resonance in Harbours of the Great Lakes
CDN 3-118-010-001	Short Period Tides in Lake Ontario (IFYGL)
USA 3-103-010-001	IFYGL Rawinsonde System: Description of Archived Data
USA 3-021-003-001	Available Phosphorus in Urban Runoff & Lake Ontario Tributary Waters
USA 1-058-002-001	Tributary stage levels observations-15 minute-digital USGS gages
USA 3-040-004-001	Optical Properties of Lake Ontario
USA 1-061-001-001/003	NOAA 2 VHRR Digital Tapes
USA 1-061-001-004/010	NOAA 2 VHRR Digital Tapes
USA 3-013-001-001	Soil Moisture Neutron Probe Strip Charts
USA 3-013-002-001	Soil Moisture Tabulated Data
USA 3-013-003-001	Snow Depth - Water Equivalent
USA 3-013-004-001	Observation Well Data
USA 3-052-003-001	Groundwater Data and Computation Sheets
USA 3-052-004-001	Groundwater Provisional Reports
USA 3-118-002-018	IFYGL Bulletin No. 18
CDN 3-118-011-001	Final Canadian Data and Information Catalog
USA 1-061-001-011/019	NOAA 2 VHRR Digital Tapes
USA 1-061-001-011	NOAA 2 VHRR Replacement
USA 3-100-020-002	Notebook of Intercomparison Data
USA 3-100-020-003	Texas Instrument Original Notes and Specs.
USA 3-100-020-004	Texas Instrument Original Notes and Specs.

USA 8-106-002-xxx	RFF Nose Camera Film (16 Reels of 16mm color film)
USA 8-106-003-xxx	RFF Right side Camera (8 reels of 35mm B/W film)
USA 8-106-004-xxx	RFF Left side Camera (8 reels of 35mm B/W film)
USA 8-106-005-xxx	RFF Photo Panel Camera (9 reels of 35mm B/W film)
USA 4-100-014-xxx	Sensor Calibration Cards (For Temporary Hold)
USA 3-100-014-001	Sensor Calibration Listing (For Temporary Hold)
USA 1-106-001-xxx	RFF Basic Met. System Tapes (31 Tapes and 31 Copies)

Status of the Archive

Tables and show the availability of IFYGL data, primarily from the United States Archive. The following data are in the tables:

TASK NO. - The task numbers used for project identification.

INVESTIGATOR - Principal Investigator's name. The line numbers contained in the column identify groups of data. Line numbers not shown here relate to data collected but not placed in the final IFYGL Archive.

DESCRIPTION OF DATA - The underlined words are abbreviated task titles. The data or reports are described briefly.

MEDIA - These are not the media in which the data were received from the investigator, but are the media in which the data will be archived. In the United States final Archive, data will be preserved and distributed in the forms of magnetic tapes (digitized data), microfiche (reports), and microfilm (data that will not fit the other two media). Punched cards and papers will be converted to one of the preceding media for permanent retention, but will be retained for convenience until their usefulness has passed.

DATA AVAILABLE FROM INVESTIGATOR - Data on hand are identified ("At NCC") and estimated dates are given when known. "Now" means that the data are on hand at the Principal Investigator's location.

ARCHIVE - This tells the disposition of the data as follows:

Y - Yes - The data will be archived permanently.

YC - Yes - Copy to Canadian Data Bank. The data will be archived permanently and Canada has requested a copy for filing.

T - Temporary Archive. Data will be held until their usefulness is believed over.

PI - Principal Investigator. Data will be kept by the Principal Investigator, who should be contacted if the data are needed.

Requests for data should be directed to:

IFYGL Data Manager, Room 17
National Climatic Center, EDS, NOAA
Federal Building
Asheville, NC 28801

Telephone: 704 258 2850, ext. 754; FTS 672 0754

Table 3.--Summary of data available from final IFYGL Archive: United States

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: ATMOSPHERIC BOUNDARY LAYER			
3	Bean		RFF/DC-6 (Gust Probe)			
		3.	Reduced turbulence data - Digital	Mag Tape	At NCC	Y
		4.	Computed flux, Time series spectra	Microfilm	At NCC	YC
		5.	Time series graphics(U,V,W,T,PV)	Microfilm	At NCC	YC
		6.	Means, Variances and Fluxes	Microfilm	At NCC	YC
		7.	Plots of Flight Paths	Microfiche	At NCC	YC
		8.	Spatial-Temporal Variations in Turbulence Fluxes	Microfiche	At NCC	YC
5	Businger		Profile Mast and Tower			
		5.	Computed profile & Flux data, 15 minute and hourly averages	Mag Tape	At NCC	YC
		6.	Report-Profile Measurements in the Atmospheric Surface Layer	Microfiche	At NCC	YC
		7.	Eddy Correlation Fluxes	Mag Tape	Not Known	Y
14	Estoque		Boundary Layer Structure			
		1.	Land Met. Stations - Surface Met. Data	Strip Chart	Now	PI
		3.	Tethered balloon (BLIP)	Microfilm	At NCC	YC
		6.	NCAR Queen Air ACFT - Processed data listing - 1 sec. sample rate	Microfilm	Now	PI
		7.	PIBAL observations-wind components	Microfilm	At NCC	YC
		8.	Cloud Cover Photography - Time lapse	16MM Film	Now	PI
		9.	Cloud Cover Photography - Still	Negatives	Now	PI
15	Estoque		Mesoscale Simulation Studies			
		1.	Annual Report - Content of Mesoscale Disturbances by Synoptic Conditions	Microfiche	At NCC	YC
		2.	Final Reports (3)	Microfiche	Not Known	YC
20	Almazan		Boundary Layer Flux Synthesis			
		1.	Final Report	Microfiche	Not Known	YC
38	Panofsky		Turbulence-Niagara Bar Tower			
		3.	Reduced wind speed fluctuations	Mag Tape	Now	PI
		5.	Two-Point Statistics over Lake Ontario	Microfiche	At NCC	YC
63	Telford		NCAR/DRI Aircraft			
		2.	Reduced data - Gust probe, met sensors	Mag Tape	Now	PI
		3.	Reduced data - (Time, location, U, V, W, temperature, dew point, pressure)	Mag Tape	Now	PI
		4.	Reduced data, Calcomp Plot - Aircraft Track 6-sec. wind vectors	Sheets	Now	PI
		5.	Final data report-Computed fluxes of momentum, heat, vapor (1/minute)	Microfiche	Not Known	YC
		6.	Final Report	Microfiche	Not Known	YC
		7.	Measurement of Wind:Instruments & Accuracy	Microfiche	At NCC	YC
			PANEL: BIOLOGY - CHEMISTRY			
1	Armstrong		Sediment Analysis			
		2.	Phosphorus Uptake-Release by Sediments	Microfiche	At NCC	YC
4	Burris		Nitrogen Fixation			
		2.	Final Report	Microfiche	At NCC	YC
6	Kutkuhn		Status of Fish Population			
		1.	Fish samples-Size,Numbers,Scale collections (From punched cards)	Mag Tape	At NCC	YC
		2.	Fish samples-Size,Numbers,Scale collections (From punched cards)	Listing	At NCC	T
		3.	Water temperature (BT) (From punched cards)	Mag Tape	At NCC	YC
		4.	Digitized BT, 5 Fathoms	Listing	At NCC	T

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
		PANEL: <u>BIOLOGY - CHEMISTRY (Cont'd)</u>			
6	(Cont'd) 5.	RESEARCHER Fathometer (Echo Sounding)	Rolls	Now	PI
	6.	Final Report	Microfiche	Not Known	YC
7	Casey	<u>Material Balance</u>			
	1.	Material balance data in STORET	STORET	At NCC	Y
	3.	Final Report - Streams	Microfiche	Not Known	YC
	4.	Final Report - Main Lake	Microfiche	July 1976	YC
	5.	Empirical Model for Nutrient Accumulation Rates	Microfiche	At NCC	YC
12	Thomas	<u>Rochester Embayment Study</u>			
	2.	Chemical Data	Mag Tape	Now	PI
	4.	Current speed and direction, water temperature, wind	Mag Tape	At NCC	YC
	10.	Gravity Magnetic Survey	Mag Tape	At CEDDA	PI
	11.	RESEARCHER Fathometer Soundings	Strip Ch.	Now	PI
	12.	Final Report	Microfiche	At NCC	YC
19	Hetling	<u>Transport of Nutrients and Pollutants</u>			
	1.	Transport data in STORET	STORET	At NCC	Y
	3.	Final Report (Genessee River Basin)	Microfiche	Not Known	YC
21	Lee	<u>Hazardous Material Flow</u>			
	1.	Final Report	Microfiche	Not Known	YC
	3.	Available Phosphorus in Urban Runoff	Microfiche	At NCC	YC
22	Kim	<u>Remote Measurement of Chlorophyll</u>			
	1.	Report - New Algae Mapping Technique	Microfiche	At NCC	YC
26	Lee	<u>Algal Nutrient Availability</u>			
	3.	Final Report	Microfiche	Not Known	YC
29	McNaught	<u>Zooplankton Production</u>			
	1.	Zooplankton data in STORET	STORET	Not Known	Y
	4.	Acoustical Profiles	Sheets	Now	PI
	5.	Zooplankton Concentration Worksheets	Pages	Now	PI
	6.	Final Report	Microfiche	Not Known	YC
33	Moore	<u>Nearshore Study</u>			
	1.	Nearshore data in STORET	STORET	At NCC	Y
	5.	Final Report	Microfiche	Not Known	YC
35	Mozley	<u>Benthos Study</u>			
	1.	Benthos study data in STORET	STORET	Not Known	Y
	3.	EBT's-ADVANCE II, Cruise 26	Microfiche	At NCC	YC
	4.	Final Report	Microfiche	Not Known	YC
44	Bell	<u>Oswego Harbor Studies (SHENEHON)</u>			
	2.	SHENEHON 6-minute Met. Data	Mag Tape	Not Known	YC
	3.	Solar Radiation Incident & Reflected	Charts	Now	PI
	5.	Chemical/digitized BT (1 meter)	Mag Tape	Not Known	YC
	6.	Final Report (Oswego Harbor)	Microfiche	Not Known	YC
46	Polcyn	<u>Cladophora Sensing</u>			
	1.	Cladophora Distribution	Microfiche	At NCC	YC
47	Polcyn	<u>Suspended Sediments Sensing</u> No special report for this task. See Final Report for Task 45, Remote Sensing - Terrain -			

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: BIOLOGY - CHEMISTRY (Cont'd)			
60	Stoermer		Phytoplankton Composition and Abundance			
		3.	Data count Pre-report	Microfiche	At NCC	YC
		4.	Data Analysis-Lakewide Changes	Microfiche	At NCC	YC
		5.	Phytoplankton Composition & Abundance	Microfiche	At NCC	YC
62	Sweeney		River Discharge Bio-Chemical Impacts			
		1.	Nearshore Bio-Chem STORET data	STORET	At NCC	Y
		6.	Final Report	Microfiche	Not Known	YC
64	Thomann		Eutrophication Model			
		1.	Final Report	Microfiche	Not Known	YC
		2.	Modeling of Phytoplankton	Microfiche	At NCC	YC
66	Thomas		Sediment Oxygen Demand			
		1.	Sediment oxygen data in STORET	STORET	At NCC	Y
		4.	Final Report	Microfiche	Not Known	YC
67	Thomas		Lake Macrobenthos			
		1.	Distribution of Benthic Organisms	Microfiche	Not Known	YC
		2.	Sediment Particle Size,Composition	Microfiche	Not Known	YC
		3.	Final Report	Microfiche	Not Known	YC
		4.	Chlorophyll a Profiles	Microfiche	At NCC	YC
68	Lee		Hazardous Chemicals			
		1.	Hazardous chemical STORET data	STORET	At NCC	Y
		5.	Final Report-Chlorinated Hydrocarbons	Microfiche	At NCC	YC
71			Invertebrate Fish Forage Organisms			
		1.	Fish Food Habits Data	Mag Tape	At NCC	YC
		2.	Final Report	Microfiche	Not Known	YC
73	Pinsak		Lake Water Characteristics			
		1.	Edited Depth, Temperature, Chemical composition data	Mag Tape	At NCC	YC
76	Robertson		Fauna List			
		1.	Final Report	Microfiche	Not Known	YC
78	Robertson		Carbon Cycle Model			
		1.	Final Report - Carbon Cycle Model	Microfiche	June 1976	YC
		2.	Final Report - Carbon Budget	Microfiche	At NCC	YC
			PANEL: ENERGY BALANCE			
2	Atwater		Net Radiation			
		1.	Interim Reports	Microfiche	At NCC	YC
		2.	Net radiation data for grid	Mag Tape	At NCC	YC
		3.	Final Report - Cloud Cover Radiation - Vol.I Program Specs. - Vol.II	Microfiche	At NCC	YC
17	Dilley		Nearshore Ice Formation			
		2.	Meteorological data-Van (Temperature, Wind, Radiation,Pressure)	Mag Tape	Not Known	YC
		3.	Time lapse photography (Ice Formation)	Film	Now	PI
		4.	Analysis of Lake Shore Ice Formation, Growth, and Decay-IFYGL Phase 2	Microfiche	At NCC	YC
		5.	Data Report	Microfiche	At NCC	YC
18	Grumblatt		Advection Term-Energy Balance			
		2.	Water temperature,5-minute intervals	Mag Tape	At NCC	YC
		3.	Final Report	Microfiche	Not Known	YC

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: ENERGY BALANCE (Cont'd)			
28	Lyons		Cloud Climatology			
		1.	Solar Radiation-Incident	Strip Ch.	Now	PI
		2.	1 Hour averages (Planimetered)	Microfiche	Aug 1976	YC
		3.	Cloud photography-Color Panorama	35 MM Film	Now	PI
		4.	Cloud photography-Color All Sky	16 MM Film	Now	PI
		5.	Cloud photography-Other	35 MM Film	Now	PI
		7.	Final Report	Microfiche	Aug 1976	YC
40	Piech		Lake Optical Properties			
		3.	Turbidity Measurements-Irradiance Meter/Transmissometer-graphs	Sheets	Now	PI
		4.	Turbidity Measurements - Irradiance meter/transmissometer - graphs	Microfiche	At NCC	YC
		5.	Documentation-Location of measurements Final Report	Microfiche	Not Known	YC
41	Pinsak		Lake Heat Storage			
		1.	Weekly mean water temperatures for lake cells	Microfiche	Not Known	YC
		2.	Final Report	Microfiche	Not Known	YC
42	Pinsak		Sensible & Latent Heat Flux			
		1.	Final Report	Microfiche	Not Known	YC
43	Pinsak		Lake Thermal Advection			
		1.	Final Report	Microfiche	Not Known	YC
54	Quinn		Ice Studies for Storage Term			
		1.	Ice Thickness - Manual Measurement A. 5 sites, weekly B. Ice patterns-graphic display C. Surface meteorological data D. Albedo measurement	Microfiche	At NCC	YC
61	Strong		Clouds, Ice, and Surface Temp.-Satellite			
		1.	NOAA 2 VHRR Digital Tapes	Mag Tape	At NCC	Y
		2.	NOAA 2 VHRR Images for above tapes	Film	At NCC	T
		3.	Final Report-Utilizing NOAA Sat. Data	Microfiche	At NCC	YC
			PANEL: LAKE METEOROLOGY			
36	Hoffeditz		Evaporation Pan Network (US & CDN)			
		1.	Radiation, Incident LW & SW hourly totals	Pun'd Cards	Not Known	YC
		2.	Evaporation Pan data (US & CDN)	Pun'd Cards	Not Known	YC
		4.	Four Reports & Final Report	Microfiche	Not Known	YC
50	Rasmusson		Atmospheric Water Balance			
		1.	Heat and Water Budget Computations	Microfiche	Not Known	YC
		2.	Final Report	Microfiche	Not Known	YC
			PANEL: TERRESTRIAL WATER BALANCE			
8	Schutze		Runoff			
		1.	Weekly streamflow data	Microfiche	Not Known	YC
		2.	Summary Report	Microfiche	Not Known	YC
9	Schutze		Evaporation (Lake-Land)			
		1.	Weekly evaporation estimates	Microfiche	Not Known	YC
		2.	Final Report	Microfiche	Not Known	YC
10	DeCooke		Simulation Studies			
		1.	Final Report	Microfiche	Not Known	YC

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: TERRESTRIAL WATER BALANCE (Cont'd)			
11	Weiser		Lake Precipitation			
		1.	Monthly precip estimates-US Basin	Microfiche	Not Known	YC
		2.	Final Report	Microfiche	Not Known	YC
13	Embree		Soil Moisture and Snow Hydrology			
		1.	Soil Moisture Neutron Probe Strip Charts	Microfilm	At NCC	YC
		2.	Soil moisture tabulated data	Microfiche	At NCC	YC
		3.	Snow Depth-Water equivalent	Microfiche	At NCC	YC
		4.	Observation Well Data	Microfiche	At NCC	YC
		5.	Final Report	Microfiche	Not Known	YC
16	Stoughton		Lake Level Transfer			
		1.	Final Report	Microfiche	Not Known	YC
23	Cox		Outflow Term TWB			
		1.	Discharge St. Lawrence River	Mag Tape	At NCC	YC
		2.	Final Report	Microfiche	At NCC	YC
24	Cox		Flow Model			
		1.	Final Report	Microfiche	Dec 1976	YC
30	Wilshaw		Lake Storage Term (Water Levels)			
		2.	5-minute water levels	Mag Tape	At NCC	YC
		3.	Raw hourly water levels	Mag Tape	Not Known	T
		4.	Edited (Converted to common datum)hourly water levels	Mag Tape	At NCC	YC
		5.	Final Report	Microfiche	Not Known	YC
31	Schutze		Soil Moisture			
		1.	Weekly soil moisture data	Microfiche	Not Known	YC
		2.	Final Report	Microfiche	Not Known	YC
39	Peck		Airborne Snow Reconnaissance			
		2.	Ground Truth Data	Microfiche	At NCC	YC
		3.	Airborne Survey Water Equivalent	Microfiche	At NCC	YC
		4.	Soil moisture measurements	Microfiche	At NCC	YC
		5.	Snow cover water equivalents	Microfiche	At NCC	YC
		6.	Water equivalent - air survey	Microfiche	At NCC	YC
		7.	Final Report (Task Summary)	Microfiche	Not Known	YC
45	Polcyn		Remote Sensing - Terrain			
		2.	Aerial photography - Color	70mm Film	Now	PI
		3.	Aerial photography - Black/White Prints	Film	Now	PI
		4.	Aerial photography - Black/White Negatives	Film	Now	PI
		6.	An ERTS-1 Investigation for Lake Ontario	Microfiche	At NCC	YC
		7.	Aircraft flight data record	Microfiche	At NCC	YC
		8.	Analysis of Hydrological Features	Microfiche	At NCC	YC
48	Quinn		Island - Land Precipitation			
		2.	Hourly precipitation amounts	Mag Tape	At NCC	YC
		3.	Precipitation - 80 NWS stations	Mag Tape	At NCC	YC
		4.	Daily Lake Ontario Basin precipitation	Microfiche	At NCC	YC
		5.	Over Lake Precipitation Report	Microfiche	Now Known	YC
		6.	Over Land Precipitation Report	Microfiche	At NCC	YC
		7.	Eastern Lake Precipitation Network	Microfiche	At NCC	YC
51	Quinn		Evaporation Synthesis			
		1.	Final Report	Microfiche	June 1977	YC
52	Rhodehamel		Groundwater Wells			
		2.	Water levels, analog-continuous	Strip Ch.	Now	PI
		3.	Data and Computation Sheets	Microfiche	At NCC	YC
		4.	Provisional Report	Microfiche	At NCC	YC

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: TERRESTRIAL WATER BALANCE (Cont'd)			
58	Schultz		Runoff			
		1.	Tributary stage levels - strip charts (4 USGS gages)	Microfilm	At NCC	YC
		2.	Tributary stage levels observations 15 minute-digital USGS gages	Mag Tape	At NCC	YC
		3.	Tributary stage levels - daily data	Mag Tape	Now	PI
		4.	Tributary stage levels	Pun'd Cards	At NCC	T
		5.	Mean weekly flow	Microfiche	At NCC	YC
		6.	Tributary stage & discharge, 35 miscellaneous sites - intermittent	Microfiche	At NCC	YC
		7.	NY State Barge Canal data	Microfiche	At NCC	YC
		8.	Final Report	Microfiche	At NCC	YC
69	Wilson		Radar and Precipitation Gage Network			
		1.	Raw radar data-returned echo intensity-compacted	Mag Tape	Now	PI
		3.	Photographs of radar scope	Microfilm	At NCC	Y
		4.	Daily total precipitation amounts including precipitation gage data	Mag Tape	At NCC	YC
		5.	Radar Documentation	Pages	At NCC	T
		6.	Oswego Radar Event Logs	Pages	At NCC	T
		7.	Raw precipitation data-Rochester precipitation network	Paper Tape	At NCC	T
		8.	Documentation-Rochester Precip. network observers logs	Pages	At NCC	T
		10.	Precipitation data - Rochester Network	Mag Tape	At NCC	YC
		11.	Precipitation data - Oswego Snow Network	Microfiche	At NCC	YC
		12.	Radar data hourly precipitation amounts (by storm)	Mag Tape	May 1976	YC
		13.	Avg. daily precip.,eastern Lake Ontario	Microfiche	At NCC	YC
		14.	Collection and Analyses of Digitized Radar Data - Report	Microfiche	At NCC	YC
		15.	Final Report-Radar-Gage Prec. Measurements	Microfiche	AT NCC	YC
70	Wiesnet		Aerial Hydrological Survey			
		7.	Final Report-Evaluation of ERTS-1 Sat. Data	Microfiche	At NCC	YC
74	Sykes		Snow Observation Network			
		2.	Rain Gage Charts - 13 locations	Microfilm	At NCC	Y
		3.	Student observation forms	5000 Pages	Now	PI
		4.	Replications of Ice Crystals	Slides	Now	PI
		5.	Photo of flakes, crystal types	Film	Now	PI
		6.	Final Report I. Oswego Weather Radar Project 1972/1973	Microfiche	At NCC	YC
		7.	Final Report II. Precipitation Gages plus Snowfall	Microfiche	At NCC	YC
		8.	Final Report III.Supp. Study 1973/1974	Microfiche	At NCC	YC
			PANEL: WATER MOVEMENT			
27	Liu		Waverider Buoy			
		3.	Digitized wave data(3 samples/second)	Mag Tape	At NCC	Y
		5.	Hourly summary and plot of digitized wave data	Microfilm	At NCC	YC
		6.	Final Report	Microfiche	At NCC	YC
		7.	Wave Spectra during Hurricane Agnes	Microfiche	At NCC	YC
34	Mortimer		Internal Waves - Temperature Transect			
		5.	Temperature Transects	Microfilm	At NCC	YC
		6.	Final Report	Microfiche	Not Known	YC
		7.	Internal Wave Response of Thermocline to a Storm Passage	Microfiche	At NCC	YC
		8.	Development of an Automatic Depth Profiling System	Microfiche	At NCC	YC

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: WATER MOVEMENT (Cont'd)			
37	Pandolfo		Simulation Studies			
		1.	Volume I - Final Report	Microfiche	At NCC	YC
		2.	Volume II - FORTRAN Program	Microfiche	At NCC	YC
		3.	Volume III - One-Dimensional Model	Microfiche	At NCC	YC
		4.	Volume IV - 3-Dimensional Model	Microfiche	At NCC	YC
49	Rao		Lake Circulation			
		1.	Final Report	Microfiche	Not Known	YC
55	Saylor		Lagrangian Current Observations			
		1.	Current drogue - Daily plot	Microfilm	July 1976	YC
		2.	Water temperature - Daily chart	Microfiche	July 1976	YC
		5.	Final Report	Microfiche	July 1976	YC
56	Saylor		Circulation - Currents			
		2.	Current/Wind daily charts	Pages	Now	PI
		3.	Final Report	Microfiche	July 1976	YC
59	Scott		Coastal Chain			
		1.	Current Meter Data, Water Temperature	Mag Tape	At NCC	YC
		2.	Final and Basic Data Report	Microfiche	At NCC	YC
		3.	Current Meter Data, Water Temperature	Pun'd Cards	At NCC	T
72	Csanady		Coastal Circulations			
		1.	Final Report	Microfiche	Not Known	YC
		2.	Spring Thermocline Behavior	Microfiche	At NCC	YC
77	Pickett		Physical Lake Properties			
		1.	Current, temperature analysis	Microfiche	Dec 1976	YC
		2.	Final Report	Microfiche	Dec 1976	YC
		3.	Mean Temperatures and Currents, July 1972	Microfiche	At NCC	YC
			PANEL: MAJOR SYSTEMS			
100	CEDDA		Physical Data Collection System			
		1.	Basic data - engineering counts	Mag Tape	At NCC	T
		2.	Provisional Meteorological and Limnological data - 6-Minute tapes	Mag Tape	At NCC	YC
		3.	" " " " - Data Listing	Microfilm	At NCC	YC
		4.	" " " " - Time Series Graphics	Microfilm	At NCC	YC
		5.	Final Meteorological and Limnological Data - 6-Minute Tapes	Mag Tape	At NCC	YC
		6.	" " " " - 6-Minute and Hourly Average Data Listing	Microfilm	At NCC	YC
		7.	" " " " - Time Series Graphics	Microfilm	At NCC	YC
		8.	" " " " - Hourly Average Tapes	Mag Tape	At NCC	YC
		9.	Station event logs and histories	Microfilm	At NCC	Y
		10.	System documentation	Microfiche	Oct. 1976	YC
		11.	Calibration data	Microfilm	At NCC	Y
		13.	Manual edited data	Mag Tape	At NCC	T
		14.	Sensor Calibrations	Mag Tape	At NCC	T
		15.	Translated cassette data	Mag Tape	At NCC	T
		16.	Rochester Control Center backup tapes	Mag Tape	At NCC	T
		17.	Pre-provisional time series plots	Microfilm	At NCC	T
		18.	Met Data CDN & US Buoys-Hourly Averages	Mag Tape	At NCC	Y
		19.	Precipitation sensor evaluation	Microfiche	At NCC	YC
		20.	Misc. PDCS Logs and Folders	Pages	At NCC	T
101	CEDDA		US IFYGL Ship System - RESEARCHER			
		3.	1-Second data - (1/10-Second, Subsurface)	Mag Tape	At NCC	Y
		4.	"On-station" data. 6-Minute averages and total radiation; EBT & decibar average subsurface data	Mag Tape	At NCC	YC

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: <u>MAJOR SYSTEMS (Cont'd)</u>			
101	(Cont'd)	5.	DAS Documentation Calibration, Bridge event logs	Pages	At NCC	T
		6.	DAS Documentation, Logs, and Traces	Microfilm	At NCC	T
		7.	Time Series Graphics - 6-Minute averages	Microfilm	At NCC	YC
		8.	Manual observations - Raw	Pages	At NCC	T
		9.	Manual observations - Edited	Mag Tape	At NCC	YC
		10.	Quality Control Strip Charts	Strip Ch.	Now	T
		11.	EBT - 9-Point digitized	Mag Tape	At NCC	Y
		12.	EBT - X,Y traces	Microfilm	At NCC	Y
		13.	Time Series Graphics, 1-Second data	Microfilm	At NCC	Y
		14.	EBT Graphics	Microfilm	At NCC	Y
		15.	1-Second Data Listing	Microfilm	At NCC	T
		16.	RESEARCHER Dissolved oxygen traces	Microfilm	At NCC	Y
		17.	Barograph charts	Microfiche	At NCC	YC
		18.	Processing documentation	Microfiche	Not Known	YC
		19.	XBT data	Microfilm	At NCC	Y
		20.	XBT data - digitized at NODC	Mag Tape	At NCC	YC
		21.	System manuals	Pages	At NCC	T
		22.	Navigation plots and graphics	Charts	At NCC	T
		23.	DAS Tapes	Mag Tape	At NCC	T
102	CEDDA		<u>US IFYGL Ship System - ADVANCE II</u>			
		3.	1-Second data - (1/10-Second, Subsurface)	Mag Tape	At NCC	Y
		4.	"On-station" data. 6-Minute averages and total radiation; EBT & decibar average subsurface data	Mag Tape	At NCC	YC
		5.	DAS Documentation, Calibration, Bridge event logs	Microfilm	At NCC	T
		6.	DAS Documentation, Logs, and Traces	Microfilm	At NCC	T
		7.	Time Series Graphics - 6-Minute averages	Microfilm	At NCC	YC
		8.	Manual observations - Raw	Pages	At NCC	T
		9.	Manual observations - Edited	Mag Tape	At NCC	YC
		10.	Quality Control Strip Charts	Strip Ch.	Now	T
		11.	EBT - 9-Point digitized	Mag Tape	At NCC	Y
		12.	EBT - X,Y traces	Mag Tape	At NCC	Y
		13.	Time Series Graphics, 1-Second data	Microfilm	At NCC	Y
		14.	EBT Graphics	Microfilm	At NCC	Y
		15.	1-Second Data Listing	Microfilm	At NCC	T
		16.	Processing documentation	Microfiche	Not Known	YC
		17.	Navigation plots	Charts	At NCC	T
103	CEDDA		<u>Rawinsonde</u>			
		2.	Raw rawinsonde data copy of data tapes	Mag Tape	At NCC	T
		3.	Raw data - Met. parameters	Strip Ch.	At CEDDA	PI
		4.	Raw Data - Time Series Plots	Microfilm	At NCC	Y
		5.	Final data - 5 Second Averages	Mag Tape	At NCC	Y
		6.	Final data - 10 Millibar Increments	Mag Tape	At NCC	YC
		7.	Final data - 50 Millibar Increments	Mag Tape	At NCC	YC
		8.	Adiabatic charts and listing	Microfilm	At NCC	YC
		10.	Description of archived data	Microfiche	At NCC	YC
		11.	Down Track Trace	Mag Tape	Now	PI
		13.	Documentation and basic information	Microfilm	At NCC	Y
		15.	Unedited, unpacked, raw data	Mag Tape	At NCC	T
106	CEDDA		<u>Research Flight Facility (RFF)</u>			
		1.	RFF Basic Meteorological System	Mag Tape	At NCC	Y
		2.	Color Nose Camera	16mm Film	At NCC	Y
		3.	B/W Right Side Camera	35mm Film	At NCC	Y
		4.	B/W Left Side Camera	35mm Film	At NCC	Y
		5.	RFF Photo Panel Camera	35mm Film	At NCC	Y
110	EPA		<u>STORET Data</u>			
		1.	Jan. 1975 Readout - Fiche	Microfiche	At NCC	TC
		2.	Jan. 1975 Readout - Film	Microfilm	At NCC	TC
		3.	Final Chemistry & Quality data - Fiche	Microfiche	At NCC	YC

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: MAJOR SYSTEMS (Cont'd)			
110	(Cont'd)	4.	January 1975 Readout - Tape	Mag Tape	At NCC	T
		5.	Final Chemistry & Quality data - Tape	Mag Tape	At NCC	Y
		6.	Final Chemistry & Quality data - Inventories	Listing	At NCC	T
		7.	Final Biological Data - Tape	Mag Tape	Not Known	Y
118	IFYGL		Miscellaneous IFYGL Reports			
		1.	Technical Plan	Microfiche	At NCC	YC
		2.	Bulletin	Microfiche	At NCC	YC
		3.	Technical Manual Series	Microfiche	At NCC	YC
		4.	Scientific Series	Microfiche	At NCC	YC
		5.	Two Nations, One Lake	Microfiche	At NCC	YC
		6.	Proceedings, IFYGL Symposium, AGU	Microfiche	At NCC	YC
		7.	First Annual Report, EPA	Microfiche	At NCC	YC
		8.	Objective Analysis of Surface Met. Data	Microfiche	At NCC	YC
119	Robertson		IFYGL Intercomparisons			
		1.	Intercomparison Data & Methods	Microfiche	Not Known	YC
		2.	Final Report	Microfiche	Not Known	YC
		3.	Chemical Intercomparisons	Microfiche	At NCC	YC
			PANEL: SUPPLEMENTARY DATA			
200	NCC/NOAA		Hourly Surface Aviation			
		1.	Surface Weather Observations - Forms	Paper	Now	PI
		2.	Surface Weather Observations - Digitized	Mag Tape	Now	PI
		3.	Surface Weather Observations - Film	Microfiche	Now	PI
205	NCC/NOAA		Synoptic Observations			
		1.	Original 3 & 6-Hourly Synoptic Obs.	Paper	Now	PI
		2.	Original 3 & 6-Hourly Synoptic Obs., Fiche	Microfiche	Now	PI
210	NCC/NOAA		Daily Co-op Observations			
		1.	Record of Climatological Obs.	Paper	Now	PI
		2.	Record of Climatological Obs., Digitized	Mag Tape	Now	PI
215	NCC/NOAA		Climatic Summaries			
		1.	Local Climatological Data	Paper	Now	PI
		2.	Prel. Local Climatological Data	Paper	Now	PI
		3.	Climatological Data	Paper	Now	PI
220	NCC/NOAA		Ships of Opportunity			
		1.	Great Lakes Vessel Reporting Form	Paper	Now	PI
		2.	Great Lakes Vessel Reporting Form-Digitized	Mag Tape	Now	PI
225	NCC/NOAA		RADAR Observations			
		1.	Radar Log	Paper	Now	PI
		2.	Radar Film (Also see Task 69TW)	Microfilm	Now	PI
230	NCC/NOAA		Station History/Instrumentation			
		1.	NWS Station Description Forms	Paper	Now	PI
235	NCC/NOAA		Solar Radiation			
		1.	Hourly/Daily Digitized Data	Mag Tape	Now	PI
		2.	Hourly/Daily Forms	Paper	Now	PI
		3.	Hourly/Daily Instrument Charts	Charts	Now	PI
240	NCC/NOAA		Recorder Charts			
		1.	Gust Recorder	Paper	Now	PI
		2.	Triple Register	Paper	Now	PI
		3.	Barograms	Paper	Now	PI
		4.	Rain Gage	Paper	Now	PI
		5.	Rain Gage	Mag Tape	Now	PI

Table 3.--Summary of data available from final IFYGL Archive: United States (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAIL-ABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: SUPPLEMENTARY DATA (Cont'd)			
245	NCC/NOAA		Analyzed Maps/Chsrts			
		1.	NMC Charts	Microfilm	Now	PI
		2.	NMC Charts	Paper	Now	PI
261	NCC/NOAA		Lake Data			
		1.	Monthly Bulletin of Lake Levels	Report	Now	T
		2.	Great Lakes Water Levels	Report	Now	T
280	NCC/NOAA		Other			
		1.	Aerial Photographs of Rochester	Prints	Now	T

Table 4.--Summary of data available from final IFYGL Archive: Canada

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: <u>ATMOSPHERIC BOUNDARY LAYER</u>			
5	Donelan		<u>Direct Measurement of Energy Fluxes</u>			
		1.	Niagara Bar Micromet Data-10 min.	Mag Tape	At NCC	Y
		2.	30-Min Ave. radiation	Microfilm	At NCC	Y
		3.	Determination of Aerodynamic Drag Coefficient	Microfiche	At NCC	Y
		4.	Generalized Profiles	Microfiche	At NCC	Y
15	McBean		<u>Space Spectra in the Free Atmosphere</u>			
		1.	Mesoscale low-level flight data	Mag Tape	At NCC	Y
		2.	Mesoscale low-level flight data	Microfiche	At NCC	Y
28	McBean		<u>Momentum, Heat, & Moisture Transfer</u>			
		1.	Niagara Bar Micromet data	Microfiche	At NCC	Y
44	Elder		<u>Analysis of Energy Fluxes</u>			
		2.	Preliminary estimates	Microfiche	At NCC	Y
		3	Preliminary Energy Budget	Microfiche	At NCC	Y
		4.	Preliminary investigation of wind stress field over Lake Ontario	Microfiche	At NCC	Y
75	Smith		<u>Wind & Temperature Fluctuations</u>			
		1.	Niagara Bar preliminary data	Microfiche	At NCC	Y
		2.	Niagara Bar final data	Microfiche	At NCC	Y
		3.	Report-Eddy Flux Measurements	Microfiche	At NCC	Y
97	Elder		<u>Meteorological Buoy Measurements</u>			
		1.	10-min observational data & 1 hour averaged data	Mag Tape	At NCC	Y
		2.	Prelim Invest-Wind Stress Field	Microfiche	At NCC	Y
		3.	Field Report	Microfiche	At NCC	Y
		4.	Summary of Met. Buoy & Manual Measurements	Microfiche	At NCC	Y
		5.	A Met. Buoy System for Great Lakes Studies	Microfiche	At NCC	Y
		6.	Listings	Microfilm	At NCC	Y
107	Whelpdale		<u>Air Pollution Sinks</u>			
		1.	Sulphate deposition by precipitation	Microfiche	At NCC	Y
			PANEL: <u>BIOLOGY - CHEMISTRY</u>			
54	Gorman		<u>Groundwater Supply Near Kingston</u>			
		1.	Geochemical Study of Deadman Bay	Microfiche	At NCC	Y
81	Salbach		<u>Material Balance Lake Ontario</u>			
		1.	Water quality info - preliminary	Microfiche	At NCC	Y
		2.	Water quality data - tributary streams	Microfiche	At NCC	Y
82	Roff		<u>Lake Ontario Zooplankton Migration</u>			
		1.	Energetics of Vert. Migration	Microfiche	At NCC	Y
83	Christie		<u>Cooperative Studies of Fish Stocks</u>			
		1.	Times, locations of trawl drags	Microfiche	At NCC	Y
		2.	Effects on the Salmonid Community	Microfiche	At NCC	Y
		3.	Changes in Fish Species Composition	Microfiche	At NCC	Y
84	Owen		<u>Cladophora Growth</u>			
		1.	Location and Extent of Cladophora	Microfiche	Not Known	Y
85	Fraser		<u>Nutrient Cycles, Lake Ontario</u>			
		1.	Phosphorus & Nitrogen Transects	Microfiche	At NCC	Y

Table 4.--Summary of data available from final IFYGL Archive: Canada (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: BIOLOGY - CHEMISTRY (Cont'd)			
86	Nicholson		Lake Ontario Surface Plankton Survey			
		1.	Pigment Analysis: Chlorophyll "A"	Microfiche	At NCC	Y
98	Munawar		Lake Ontario Cross-Section Study			
		2.	Abundance of Diatoms, SW Nearshore	Microfiche	At NCC	Y
101	Munawar		Lake Ontario Primary Production Study			
		1.	Measurement and Prediction	Microfiche	At NCC	Y
		2.	Primary production at an Inshore & Offshore Station	Microfiche	At NCC	Y
		3.	Phytoplankton, biomass, species composition and primary production	Microfiche	At NCC	Y
102	Glooschenko		Lake Ontario Diel Pigment Variation			
		1.	Diel Chlorophyll "A" Variations	Microfiche	At NCC	Y
103	Gilbertson		Pesticide Concentration in Birds' Eggs			
		1.	Seasonal Changes, Terns, Hamilton	Microfiche	At NCC	Y
104	Shiomi		Rain Quality Monitoring			
		1.	Composition of Precipitation	Microfiche	Not Known	Y
			PANEL: ENERGY BALANCE			
8	Robertson		Shore Gauging Stations			
		1.	Hourly averaged water temperature	Mag Tape	At NCC	Y
		2.	Key Punch Card Documentation	Microfiche	At NCC	Y
		3.	Documentation of System	Microfiche	Not Known	Y
32	Rodgers		Thermal Bar Study			
		1.	Energy Budget Study	Microfiche	At NCC	Y
42	Boyce		Heat Storage of Lake Ontario			
		1.	Heat Content Survey Report #1	Microfiche	At NCC	Y
		2.	Heat Content Survey Report #2	Microfiche	At NCC	Y
		3.	Heat Content Survey Report #3	Microfiche	At NCC	Y
		4.	Heat Content Survey Report #4	Microfiche	At NCC	Y
		5.	Heat Content Survey Report #5	Microfiche	At NCC	Y
		6.	Heat Content Survey Report #6	Microfiche	At NCC	Y
		7.	Heat Content Survey Report #7	Microfiche	At NCC	Y
		8.	Heat Content Survey Report #8	Microfiche	At NCC	Y
		9.	Heat Content Survey Report #9	Microfiche	At NCC	Y
		10.	Heat Content Survey Report #10	Microfiche	At NCC	Y
		11.	Final Report	Microfiche	Not Known	Y
		12.	River Flows and Temperature Inputs to Lake Ontario	Mag Tape	At NCC	Y
71	McCulloch		Canadian Radiation Network			
		1.	AES radiation data-see Task 80			
		3.	Instrument Location & Obstruction Charts	Microfiche	At NCC	Y
72	Ramseier		Floating Ice Research			
		1.	Navigation Season Extension Studies	Microfiche	At NCC	Y
		2.	Studies, Extension of Winter Nav.	Microfiche	At NCC	Y
73	Judge		Terrestrial Heat Flow			
		1.	Analysis of Heat Data	Microfiche	At NCC	Y
		2.	Mud Temperature Gradient	Microfiche	Not Known	Y
		3.	Thermal Conductivity of Lake Ontario	Microfiche	Not Known	Y

Table 4.--Summary of data available from final IFYGL Archive: Canada (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: ENERGY BALANCE (Cont'd)			
80	Davies		Radiation Balance Program			
		1.	Radiation data	Mag Tape	Not Known	Y
		3.	Final Report, Canadian Radiation	Microfiche	At NCC	Y
87	Boyce		Heat Flow to Lake Ontario			
			Included in Task 42 EB			
			PANEL: FIELD SUPPORT			
1	Thomson		Remote Sensing			
		1.	Lake Dynamics Utilizing Sun-Glint	Microfiche	At NCC	Y
		2.	High Altitude Remote Sensing	Microfiche	At NCC	Y
		3.	Optical Properties of the Great Lakes	Microfiche	At NCC	Y
30	Rodgers		IFYGL Operations - CCGS PORTE DAUPHINE			
		1.	Digitized EBT Data	Mag Tape	At NCC	Y
		6.	Shipboard logs and forms. Weather, EBT, conductivity, turbidity, etc.	Microfilm	At NCC	Y
68	Sly		CCIW Supporting Resources			
		1.	Shipboard data - STAR Format	Mag Tape	At NCC	Y
		2.	Description of STAR System	Microfiche	.	Y
		3.	TSAR Format Documentation	Paper	At NCC	T
		4.	Shipboard EBT data	Mag Tape	At NCC	Y
		5.	Star Monitor Layout	Paper	At NCC	T
		6.	Shipboard logs and forms. Cruise reports weather obs, EBT profiles, analog records.	Microfilm	At NCC	Y
79	McCulloch		Bathymetric Surveys - Lake Ontario			
		1.	Lake Ontario Bathymetric data	Mag Tape	At NCC	Y
94	MacPhail		Data Retransmission by Satellites			
		1.	Data retransmission	Microfiche	At NCC	Y
118	Byron		Publications			
		1.	Plan of Study for IFYGL	Microfiche	At NCC	Y
		2.	Objective Analysis Surface Pressure	Microfiche	At NCC	Y
		3.	Numerical Models of Airflow	Microfiche	At NCC	Y
		4.	1971 Buoy Intercomparison	Microfiche	At NCC	Y
		5.	Canadian Projects & Supplements 1-4	Microfiche	At NCC	Y
		6.	Canadian IFYGL Data Submissions 7/31/74	Microfiche	At NCC	Y
		7.	Intercomparison - Research Aircraft	Microfiche	At NCC	Y
		8.	Hydrometeorological Studies	Microfiche	At NCC	Y
		9.	The IFYGL Field Year	Microfiche	At NCC	Y
		10.	Short Period Tides	Microfiche	At NCC	Y
		11.	Final Canadian Data & Information Catalog	Microfiche	At NCC	Y
250	IFYGL		Weather Summaries			
		1.	IFYGL "WEATHER DATA" Monthly	Microfiche	At NCC	Y
			PANEL: LAKE METEOROLOGY & EVAPORATION			
16	Irbe		Airborne Radiation Thermometer Surveys			
		1.	Airborne Radiation thermometer maps	Microfiche	At NCC	Y
18	McCulloch		Climatological Network			
		1.	Monthly record Canadian Met. data	Report	At NCC	T
		2.	1972 Ship data - all Lakes	Mag Tape	At NCC	Y
		4.	Hourly Weather data	Mag Tape	At NCC	Y

Table 4.--Summary of data available from final IFYGL Archive: Canada (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: LAKE METEOROLOGY & EVAPORATION (Cont'd)			
20	McCulloch		Bedford Tower Program			
		1.	Bedford Tower Met. data	Mag Tape	July 1976	Y
21	McCulloch		Canadian Shoreline Network			
		1.	Met. data: Shoreline Stations	Mag Tape	At NCC	Y
22	Lalande		Synoptic Studies			
		1.	Synoptic Studies Analysis	Microfiche	Dec 1977	Y
23	Pollock		Precipitation in Canada			
		1.	Hourly rainfall data	Mag Tape	At NCC	Y
		2.	Distrometer data	Mag Tape	At NCC	Y
24	Phillips		Climatological Studies			
		1.	IFYGL Weather Highlights	Microfiche	At NCC	Y
		2.	Surface Weather Maps	Microfilm	At NCC	Y
		3.	"Weather Data": Monthly Means & Deviations	Microfiche	At NCC	Y
25	Irbe		Lake Ontario Evaporation by Mass Transfer			
		1.	Monthly estimates	Microfiche	At NCC	Y
27	McCulloch		Island Precipitation Network			
		1.	Supplementary Precipitation data	Microfiche	At NCC	Y
64	Ferguson		Basin Evapotranspiration			
		1.	Monthly Evapotranspiration Estimates - Canadian Land Portion	Microfiche	At NCC	Y
65	Phillips		Evaporation Pan Network			
		1.	Evaporation Pan Documentation	Microfiche	At NCC	Y
66	Ferguson		Atmospheric Water Balance Study			
		1.	Atmospheric Water Balance	Microfiche	At NCC	Y
		2.	A Spectral Investigation of Horizontal Moisture Flux	Microfiche	At NCC	Y
		3.	The Atmospheric Budgets Program of IFGYL	Microfiche	At NCC	Y
67	Webb		Surface Water Temperature Distribution			
		1.	Mean Monthly Temperatures	Microfiche	At NCC	Y
117	McCulloch		APT Photographs			
		1.	ESSA-8 APT photographs	Microfilm	At NCC	Y
			PANEL: TERRESTRIAL WATER BALANCE			
11	Witherspoon		Monthly Water Balance-Lake Ontario Basin			
		1.	Hydrologic Model of the Basin	Microfiche	At NCC	Y
		2.	Storage in the Water Balance	Microfiche	At NCC	Y
12	Witherspoon		Monthly Water Balance of Lake Ontario			
		7.	An Estimate of Water Balance	Microfiche	At NCC	Y
		8.	Preliminary Lake Ontario Water Balance	Microfiche	At NCC	Y
		9.	General Water Balance of Lake Ontario	Microfiche	At NCC	Y
13	Lennox		Groundwater Flow Into Lake Ontario			
		1.	Groundwater Flow Simcoe and Ontario	Microfiche	At NCC	Y
		2.	Groundwater Inflow Canadian Side	Microfiche	At NCC	Y
14	MacDonald		Hydrology of Lake Ontario			
		1.	Tributary data	Microfiche	At NCC	Y
		2.	Daily discharge	Mag Tape	At NCC	Y

Table 4.--Summary of data available from final IFYGL Archive: Canada (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: TERRESTRIAL WATER BALANCE (Cont'd)			
38	Ostry		Groundwater Contribution			
		1.	Observation wells	Microfiche	At NCC	Y
		2.	Snow Courses	Microfiche	Not Known	Y
		3.	Soil moisture data	Microfilm	At NCC	Y
		4.	Overburden well yields	Microfiche	At NCC	Y
		5.	Hydrology of Forty Mile Creek	Microfiche	At NCC	Y
		6.	Bedrock well yields	Microfiche	At NCC	Y
		7.	Groundwater chemistry-Forty Mile Creek	Microfiche	At NCC	Y
		8.	Surficial geology,N. Shore-Newcastle	Microfiche	At NCC	Y
		9.	Hydrogeology-Bowmanville,Newcastle	Microfiche	At NCC	Y
46	Quast		St. Lawrence-Niagara Riv. Measuring Program			
		1.	Inflow measurements	Microfiche	At NCC	Y
49	Adams		Snow Stratigraphy and Distribution			
		1.	Peterborough Area: Met. data	Microfiche	Not Known	Y
		2.	Areal Differentiation of Snow Cover in East Central Ontario	Microfiche	At NCC	Y
		7.	Peterborough Area: Snow data	Microfiche	At NCC	Y
69	Henderson		Pleistocene Mapping			
		1.	Maps and charts	Microfiche	Not Known	Y
74	Dohler		Water Level Network			
		7.	Format Hrly Header & Monthly Cards	Paper	At NCC	T
		8.	Water levels,hourly. Port Weller, Toronto etc.	Mag Tape	At NCC	Y
116	Loijens		Airborne Gamma-Ray Snow Survey			
		1.	Snow-Water Equivalent	Microfiche	At NCC	Y
		2.	Experimental Snow Survey	Microfiche	At NCC	Y
		3.	Comparison of Water Equivalent	Microfiche	At NCC	Y
			PANEL: WATER MOVEMENT			
34	Rodgers		Circulation Near Toronto			
		1.	Tower current speed & direction water temperature	Mag Tape	Not Known	Y
40	Csanady		Coastal Chain Study			
		1.	Provisional Reports	Microfiche	At NCC	Y
		2.	Final Report	Microfiche	At NCC	Y
		4.	Daily Summary - Presquile	Pun'd Cards	At NCC	T
		5.	Daily Summary - Oshawa	Pun'd Cards	At NCC	T
		6.	Daily Summary - Presquile & Oshawa	Mag Tape	At NCC	Y
		7.	Baroclinic Coastal Jets	Microfiche	At NCC	Y
43	Boyce		Internal Wave Measurements			
		1.	Transect cross section	Microfiche	Dec 1976	Y
		2.	Fixed Temperature Profiler (FTP) data	Not Known	Dec 1976	Y
		3.	Transect tape (See Task 68)			
		4.	FTP data file (See Task 42)			
45	Bennett		Lake Current Measurements			
		2.	10 minute buoy current, temperature data	Mag Tape	At NCC	Y
		3.	Final Report	Microfiche	Dec 1976	Y
		4.	10 minute current, temperature data listing	Microfilm	At NCC	Y
70	Falconer		Ground Truth for Remote Sensing			
		1.	Studies in the Lake Ontario Basin using ERTS-1 and High Altitude Data	Microfiche	At NCC	Y
		2.	Flight Line Maps	Microfiche	At NCC	Y
		3.	Photo-optical Contrast Stretching of LANDSAT Data	Microfiche	At NCC	Y

Table 4.--Summary of data available from final IFYGL Archive: Canada (Continued)

TASK NO	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE
			PANEL: WATER MOVEMENT (Cont'd)			
76	Holland		Surface Wave Studies			
		1.	Final Report - Wave Climate Study	Microfiche	Unknown	Y
		2.	Wave Climate Data - Cobourg	Mag Tape	At NCC	Y
		4.	Wave Climate Data-Main Duck Island	Mag Tape	At NCC	Y
		5.	Equiv. Wave Heights vs. Period, 3 Stns.	Microfiche	At NCC	Y
		8.	Wave Climate Data - Toronto	Mag Tape	At NCC	Y
		10.	Format for Wave Climate Study	Microfiche	At NCC	Y
89	Murthy		Turbulent Diffusion Studies			
		1.	Large Scale Diffusion Studies	Microfiche	At NCC	Y
		2.	Horizontal Diffusion	Microfiche	At NCC	Y
		3.	Lagrangian and Current Measurements	Microfiche	At NCC	Y
		4.	Diffusion in Thermocline & Hypolimnion regions	Microfiche	At NCC	Y
		5.	Dispersion of Floatables	Microfiche	At NCC	Y
		6.	Observations of Lateral Shear	Microfiche	At NCC	Y
		7.	Helmholtz Resonance in Harbors	Microfiche	At NCC	Y
95	Simons		Hydrodynamical Modelling			
		6.	First Report: Model Study of Agnes	Microfiche	At NCC	Y
		7.	Model Study of Betty Storm	Microfiche	At NCC	Y
		8.	Development of Numerical Models	Microfiche	At NCC	Y
		9.	Development of Numerical Models Part 2	Microfiche	At NCC	Y
		10.	3 Dimensional Models	Microfiche	At NCC	Y
		11.	Obs. & Computed Current-Hurricane Agnes	Microfiche	At NCC	Y
		12.	Hydrodynamical Modelling Studies	Microfiche	At NCC	Y
		13.	Verification of Numerical Models Part 1	Microfiche	At NCC	Y
109	Rodgers		Upwelling Study			
		1.	Water Temp. (EBT): Included in Task 30			
110	Arajs		Hydro Intake Study			
		1.	Water current & temp.: Chub Point, Bowmanville, Weoleyville, Pickering and Lennox	Mag Tape	At NCC	Y
		2.	Nearshore Currents and Temperatures Pickering-Cobourg	Microfiche	At NCC	Y
111	Palmer		Lakeview Dispersion Study			
		1.	Current Meter Data - Lakeview	Mag Tape	At NCC	Y
		2.	Current Meter Data - Lorne Park	Mag Tape	At NCC	Y
115	Cho		Wave Climatology			
			Manual Records at CCIW			

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